



United States
Department of
Agriculture

Natural
Resources
Conservation
Service
and Forest
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Cass County, Minnesota



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How To Use This Soil Survey

General Soil Map

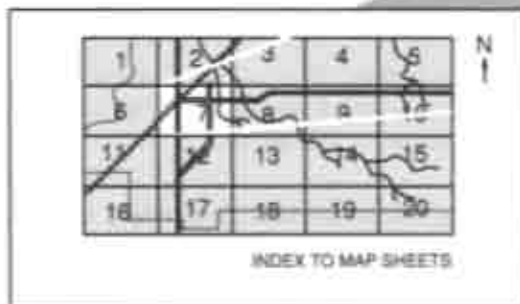
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

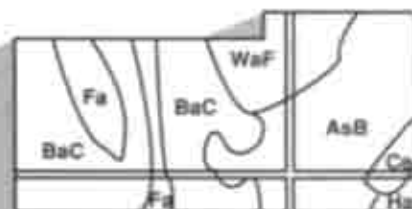
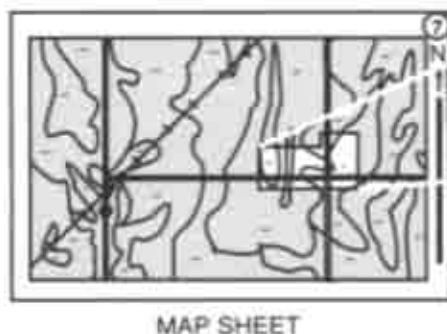
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1989. Soil names and descriptions were approved in 1993. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Natural Resources Conservation Service and the Forest Service and by the Minnesota Agricultural Experiment Station. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, the Legislative Commission for Minnesota Resources, and Cass County. The survey is part of the technical assistance furnished to the Cass Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: A typical area of Warba, Stuntz, and Cathro soils (foreground). Itasca, Goodland, and Warba soils are in the background. Woodland and recreation are the major land uses in these areas. The soils are also used as cropland, hayland, or pasture.

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Foreword

This soil survey contains information that can be used in land-planning programs in Cass County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

This publication contains no interpretations for the map units within the boundaries of the Chippewa National Forest. Information about these map units is available at the local office of the Natural Resources Conservation Service or at the Forest Service headquarters of the Chippewa National Forest.

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of Cass County, Minnesota

By Timothy N. Richardson, Natural Resources Conservation Service

Fieldwork by Timothy N. Richardson, Natural Resources Conservation Service, and
Scott A. Navratil, Theresa L. Gallagher, and Peter Hartman, Minnesota Agricultural
Experiment Station

United States Department of Agriculture, Natural Resources Conservation Service and
Forest Service,
in cooperation with
the Minnesota Agricultural Experiment Station

CASS COUNTY is in north-central Minnesota (fig. 1). It is the sixth largest county in the State. It has a total area of 1,545,700 acres.

The northern half of the county contains about 732,000 acres of the Chippewa National Forest. The National Forest Headquarters is in the city of Cass Lake.

In 1980, the population of Cass County was more than 21,000. Walker, the county seat, had a population of 970. The population of the county fluctuates substantially, depending on the season. About 23 percent of the private land is owned by people who live outside the county.

Sixty-six percent of the land in Cass County, or about 1,012,000 acres, is commercial forest land. Conifers make up 23 percent of the forest, and hardwoods, particularly aspen, make up two-thirds of the commercial forest resource. An additional 17,400 acres is noncommercial forest land, most of which consists of wooded wetlands.

Forestry and forest products are among the county's leading industries. Wood products plants are located at Pine River, Remer, Walker, Backus, and Cass Lake. Many private loggers and sawmills provide raw materials to these and other plants outside the county.

Agriculture is also a significant source of income in Cass County. Total cash receipts from agriculture were listed at \$17,155,000 in 1983.

Tourism is a major industry in Cass County. Seasonal businesses, such as resorts, marinas, sports shops, and motels, dominate northern and southeastern Cass County and bring an estimated \$110 million into the economy each year.

General Nature of the County

This section provides some general information about the survey area. It describes history; physiography, relief, and drainage; geology; and climate.

History

Stan Johnson, Cass County Historical Society, prepared this section.

Cass County was named in honor of Lewis Cass, who led an expedition to the upper Mississippi River in 1820. This expedition traveled as far as Cass Lake.

Cass County was first organized March 4, 1872, but it remained under the jurisdiction of Crow Wing County for judicial purposes until 1897 because of inadequate financial support. Walker was chosen as the county seat in 1897.

The earliest European settlers were mainly trappers, traders, and lumbermen. A few farmers settled in the southern part of the county. In 1855, the Chippewa tribe ceded the land south of Leech Lake to the Federal

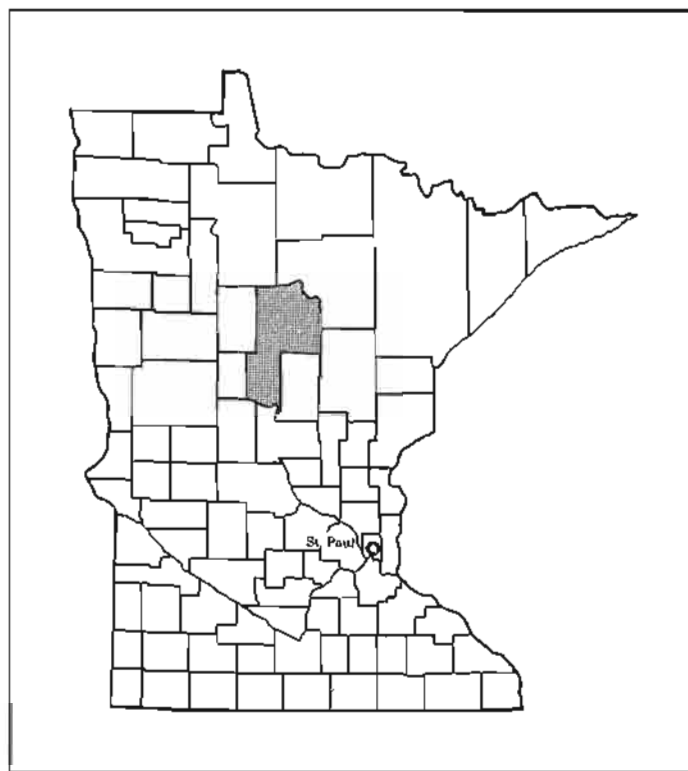


Figure 1.—Location of Cass County in Minnesota.

northeastern border with Itasca County. It reenters the county at the southeast corner, at its confluence with the Crow Wing River.

The highest point of elevation is 1,610 feet at Spider Lake Lookout Tower in the south-central part of the county. The lowest elevation is 1,150 feet at the southeast corner, just north of the point where the Crow Wing River flows into the Mississippi River.

Geology

Multiple glaciations dominated the development of the landscape of Cass County. They left a thick blanket of glacial sediments and a variety of landforms and soil types. The Wisconsin drifts are composed of four major ice lobes. These are the Wadena Lobe, the Rainy Lobe, the Superior Lobe, and the Des Moines Lobe. The type of material deposited by the glaciers depends upon the kinds of bedrock over which they crossed. The Wadena Lobe carried material from the limestone region of Manitoba, and thus it deposited yellowish brown, calcareous, loamy material. The Rainy Lobe carried material from the greenstone and granitic area of western Ontario and deposited yellowish brown, brown, and reddish brown, loamy material. The Superior Lobe carried material from the gabbro and basalt area of eastern Ontario and northeastern Minnesota and deposited reddish brown, loamy material. The Des Moines Lobe carried material from the dolomitic limestone and Cretaceous shale areas of Manitoba and deposited yellowish brown and olive brown, loamy material.

The first lobe of ice, which is called the Wadena Lobe, began moving about 30,000 years ago. At the same time, the Rainy Lobe advanced from the northeast, blocking the eastward movement of the Wadena Lobe. As the Wadena Lobe was diverted to the southwest, cigar-shaped, elongated ridges called drumlins formed in the Poplar and Leader area and westward into Wadena County. The major soils associated with these drumlins include Huntersville, Redeye, and Staples soils.

A partial retreat of the Wadena and Rainy Lobes occurred as the Wadena Lobe retreated to the area of the Itasca Moraine. About 30,000 years ago, a new advance of the Rainy and Superior Lobes sent glacial ice from northeastern Minnesota and the Lake Superior Basin into north-central Minnesota. After about 15,000 years of alternating advances and retreats, this ice sheet produced many of the surface features of central and northeastern Minnesota (Ojakangas and Matsch, 1982). To the west this ice sheet was joined to the weakly advancing Wadena Lobe. The Rainy Lobe pushed up the rugged kettle-kame topography of the St.

government. The original land surveys were conducted between 1857 and 1871. Because of the unusually fine stands of white pine, the lumber industry was historically connected to the development and growth of the area. The railroad reached Walker in 1896, and the towns along the line south to Brainerd began to boom. By the 1920's, most of the pine had been logged. Small farming operations began to spread across the county. At this time many of the lumber companies began to encourage vacationing in and around the lakes region as a method of disposing of logged lands.

Land use in present-day Cass County still centers around tourism, agriculture, and forestry.

Physiography, Relief, and Drainage

Physiography and relief in Cass County reflect the glacial history of the area. The landscape is characterized by steep, rugged moraines, rolling drumlin fields, and nearly level outwash plains.

Many of the 517 lakes in the county are interconnected by waterways that drain into six major rivers. These are the Leech Lake, Willow, Pine, Gull, Boy, and Crow Wing Rivers, all of which drain into the Mississippi River. The Mississippi River forms the

Croix Moraine. This moraine runs north and south from south of Hackensack to Pillager and continues south and east into central Wisconsin. The major soil types in this moraine include Demontreville, Menahga, Mahtomedi, and Cushing soils. The Wadena Lobe formed the Itasca Moraine, leaving behind many ice-block lakes. The Itasca Moraine area is a mixture of yellowish brown, calcareous, loamy materials. The major soil types found on this complex landscape include Warba, Stuntz, Cutaway, and Menahga soils.

The meltwaters from the Itasca and St. Croix Moraines carried sand and gravel and partially buried the drumlins in the eastern part of the Wadena drumlin field. These meltwaters collected and formed a short-lived glacial lake, called Glacial Lake Wadena, just west of the St. Croix Moraine. The waters eventually broke through at Pillager's Gap and drained out through the Crow Wing River and down the Mississippi River.

At the time of retreat of the Rainy and Superior Lobes, the Pine River drumlin field was exposed on the east side of the St. Croix Moraine. This area is characterized by the reddish brown, noncalcareous glacial till associated with the Rainy and Superior Lobes. The major soils include Wabedo, Flak, Nokay, and Pomroy soils.

The St. Louis Sublobe of the Des Moines Lobe began advancing into the survey area from the northwest about 13,000 years ago. The advance of the St. Louis Sublobe reached its maximum about 11,000 years ago and formed the Sugar Hills Moraine. The Sugar Hills Moraine contains mostly yellowish brown and olive brown, loamy materials. The major soils associated with this feature are Itasca, Goodland, Warba, and Cutaway soils.

Sometime after the retreat of the St. Louis Sublobe, a glacial lake was formed in the area of Federal Dam and eastward toward the county line. The materials in this area are lake-deposited fine sand, silts, clays, and peat.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Walker Ah Gwah Ching in the period 1961 to 1990. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 11 degrees F and the average daily minimum temperature is 1 degree. The lowest temperature on record, which occurred at Walker Ah Gwah Ching on January 21, 1954, is -39 degrees. In summer, the average temperature is 66 degrees and the average daily

maximum temperature is 77 degrees. The highest recorded temperature, which occurred at Walker Ah Gwah Ching on August 19, 1976, is 103 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 26.89 inches. Of this, 19.42 inches, or about 72 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall on record was 5.35 inches at Walker Ah Gwah Ching on August 28, 1953. Thunderstorms occur on about 34 days each year, and most occur in July.

The average seasonal snowfall is 48.6 inches. The greatest snow depth at any one time during the period of record was 50 inches on January 31, 1969. The heaviest 1-day snowfall on record was 16 inches on March 4, 1985. On the average, 115 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 64 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 59 percent of the time possible in summer and 47 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 13 miles per hour, in April.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of

soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot

experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Some soil boundaries and soil names on the maps of this survey area may not agree fully with those on the maps of adjacent survey areas that were published at an earlier date. The differences result from changes and refinements in series concepts, variations in slope groupings, and the application of the latest soil classification system.

Some areas in the county were not mapped because the soil scientists were denied access. These areas are indicated on the soil maps by a dashed line and labeled as "Denied Access." The delineations of the soils in these areas were projected using remote sensing techniques. The information provided for these areas is less reliable than that for areas that were accessible to the soil scientists.

This survey does not include interpretations for the map units within the boundaries of the Chippewa National Forest. Information about these map units is available at the local office of the Natural Resources Conservation Service or at the Forest Service headquarters of the Chippewa National Forest.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic

class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called similar inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions

of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

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General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

Nearly Level to Steep, Sandy, Loamy Over Sandy or Gravelly, and Organic Soils on Outwash Plains and Lake Plains and at the Margins of Terminal Moraines

These excessively drained, well drained, moderately well drained, and very poorly drained soils formed in sandy sediments, loamy sediments over sandy and gravelly sediments, and organic soil material. The soils in upland areas formed under pine or pine-hardwood forests, and those in the lowland areas formed under reed-sedge or spruce-tamarack vegetation.

Most areas of these soils are forested. Some areas are used as pasture, hayland, or cropland. Seedling mortality is a major management concern affecting woodland. Available water capacity, wind erosion, and wetness are major management concerns affecting cropland.

These soils make up about 24 percent of the survey area.

1. Menahga-Markey-Friendship

Nearly level to rolling soils on outwash plains

Setting

Landform and position on the landform: Side slopes, foot slopes, and depressions on outwash plains (fig. 2)

Slope range: 0 to 15 percent

Composition

Percent of survey area: 8

Extent of components in the map unit:

Menahga and similar soils—30 percent

Markey and similar soils—25 percent

Friendship and similar soils—25 percent

Minor soils—20 percent

Soil Properties and Qualities

Menahga

Drainage class: Excessively drained

Parent material: Sandy outwash

Surface texture: Loamy sand

Markey

Drainage class: Very poorly drained

Parent material: Herbaceous organic material over sandy sediments

Surface texture: Muck

Friendship

Drainage class: Moderately well drained

Parent material: Sandy outwash

Surface texture: Loamy sand

Minor Soils

- The very poorly drained Roscommon soils in depressions and drainageways
- The excessively drained Zimmerman soils on summits and side slopes
- The very poorly drained Seelyeville soils in depressions and drainageways
- The well drained Sanburn soils on side slopes, shoulders, and summits

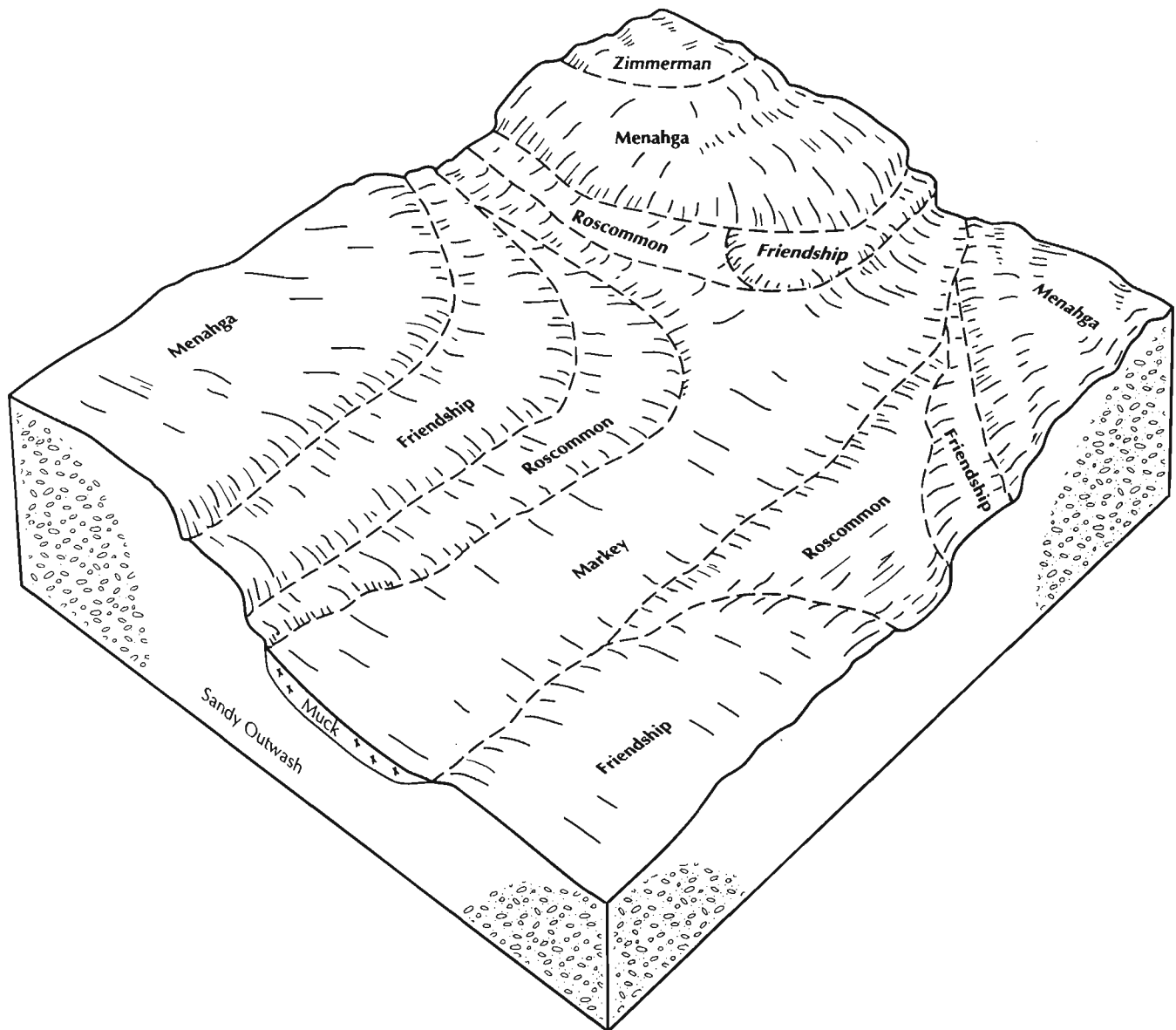


Figure 2.—Typical pattern of soils and parent material in the Menahga-Markey-Friendship general soil map unit.

Use and Management

Primary use: Woodland

Secondary uses: Pasture, hayland, cropland, recreation

Major management factors: Woodland—seedling mortality, wetness; cropland and pasture—droughtiness, wind erosion, wetness

2. Menahga-Bergkeller-Sanburn

Nearly level to rolling soils on outwash plains and at the margins of terminal moraines

Setting

Landform and position on the landform: Summits, side slopes, and foot slopes on outwash plains and at the margins of terminal moraines

Slope range: 0 to 15 percent

Composition

Percent of survey area: 9

Extent of components in the map unit:

Menahga and similar soils—25 percent

Bergkeller and similar soils—25 percent

Sanburn and similar soils—20 percent
 Minor soils—30 percent

Soil Properties and Qualities

Menahga

Drainage class: Excessively drained
Parent material: Sandy outwash
Surface texture: Loamy sand

Bergkeller

Drainage class: Well drained and moderately well drained
Parent material: Mantle of loamy till and the underlying sand and gravel
Surface texture: Sandy loam

Sanburn

Drainage class: Well drained
Parent material: Loamy mantle and the underlying sand and gravel
Surface texture: Loamy sand

Minor Soils

- The somewhat poorly drained Meehan soils on toe slopes and in slight depressions
- The moderately well drained Friendship soils on foot slopes
- The very poorly drained Markey and Rifle soils in depressions

Use and Management

Primary use: Woodland
Secondary uses: Pasture, hayland, cropland, recreation
Major management factors: Woodland—seedling mortality, plant competition; cropland and pasture—available water capacity, wind erosion, water erosion

3. Hubbard-Friendship

Nearly level to undulating soils on outwash plains

Setting

Landform and position on the landform: Slight rises, side slopes, and foot slopes on outwash plains
Slope range: 0 to 8 percent

Composition

Percent of survey area: 1
Extent of components in the map unit:
 Hubbard and similar soils—35 percent
 Friendship and similar soils—30 percent
 Minor soils—35 percent

Soil Properties and Qualities

Hubbard

Drainage class: Excessively drained
Parent material: Sandy outwash

Surface texture: Loamy sand

Friendship

Drainage class: Moderately well drained
Parent material: Sandy outwash
Surface texture: Loamy sand

Minor Soils

- The somewhat poorly drained Meehan soils on flats
- The excessively drained Menahga soils on side slopes and summits

Use and Management

Primary use: Hayland
Secondary uses: Cropland, pasture, woodland
Major management factors: Cropland and pasture—available water capacity, wind erosion, wetness; woodland—seedling mortality

4. Zimmerman-Greenwood-Rifle

Nearly level to gently sloping soils on outwash plains

Setting

Landform and position on the landform: Summits, side slopes, and depressions on outwash plains
Slope range: 0 to 8 percent

Composition

Percent of survey area: 6
Extent of components in the map unit:
 Zimmerman and similar soils—35 percent
 Greenwood and similar soils—20 percent
 Rifle and similar soils—20 percent
 Minor soils—25 percent

Soil Properties and Qualities

Zimmerman

Drainage class: Excessively drained
Parent material: Sandy outwash
Surface texture: Fine sand

Greenwood

Drainage class: Very poorly drained
Parent material: Herbaceous organic material
Surface texture: Peat

Rifle

Drainage class: Very poorly drained
Parent material: Herbaceous organic material
Surface texture: Mucky peat

Minor Soils

- The moderately well drained Hiwood soils on the lower side slopes
- The very poorly drained Roscommon soils on low flats
- The very poorly drained Mooselake and Lupton soils in depressions

Use and Management

Primary use: Woodland

Secondary uses: Pasture, hayland, cropland, recreation

Major management factors: Cropland and pasture—available water capacity, wind erosion, wetness; woodland—seedling mortality, plant competition, wetness

Nearly Level to Rolling, Loamy, Sandy Over Loamy, Silty, Clayey, and Organic Soils on Moraines and Lake Plains

These well drained to very poorly drained soils formed in loamy glacial till, sandy sediments over loamy till, clayey till, silty water-deposited sediments, and organic soil material. The soils in upland areas formed under mixed pine-hardwood forests, and those in the lowland areas formed under reed-sedge or swamp conifer.

Most areas of these soils are forested. Some areas are used as pasture, hayland, or cropland. Plant competition is a major management concern affecting woodland.

These soils make up about 24 percent of the survey area.

5. Warba-Stuntz-Cutaway

Nearly level to rolling soils on moraines

Setting

Landform and position on the landform: Summits, side slopes, and toe slopes on moraines

Slope range: 0 to 8 percent

Composition

Percent of survey area: 5

Extent of components in the map unit:

Warba and similar soils—25 percent

Stuntz and similar soils—25 percent

Cutaway and similar soils—20 percent

Minor soils—30 percent

Soil Properties and Qualities

Warba

Drainage class: Well drained

Parent material: Loamy till

Surface texture: Very fine sandy loam

Stuntz

Drainage class: Somewhat poorly drained

Parent material: Loamy till

Surface texture: Silt loam

Cutaway

Drainage class: Well drained

Parent material: Sandy sediments over loamy till

Surface texture: Loamy sand

Minor Soils

- The excessively drained Zimmerman soils on side slopes
- The somewhat poorly drained Sandwich soils on toe slopes and in slight depressions
- The very poorly drained Mooselake and Seelyeville soils in depressions and drainageways

Use and Management

Primary use: Woodland

Secondary uses: Recreation, cropland, hayland, pasture

Major management factors: Cropland and pasture—water erosion, wetness, wind erosion, available water capacity; woodland—plant competition, equipment limitations, windthrow

6. Stuntz-Spooner-Suomi

Nearly level to rolling soils on moraines and lake plains

Setting

Landform and position on the landform: Side slopes, toe slopes, and flats on moraines and lake plains

Slope range: 0 to 8 percent

Composition

Percent of survey area: 3

Extent of components in the map unit:

Stuntz and similar soils—30 percent

Spooner and similar soils—20 percent

Suomi and similar soils—20 percent

Minor soils—30 percent

Soil Properties and Qualities

Stuntz

Drainage class: Somewhat poorly drained

Parent material: Loamy till

Surface texture: Very fine sandy loam

Spooner

Drainage class: Poorly drained

Parent material: Lacustrine sediments

Surface texture: Very fine sandy loam

Suomi

Drainage class: Moderately well drained

Parent material: Clayey till

Surface texture: Loam

Minor Soils

- The moderately well drained Baudette soils on flats and slight rises
- The well drained Warba soils on side slopes and shoulders
- The very poorly drained Mooselake and Lupton soils in depressions or in deep drainageways

Use and Management

Primary use: Woodland

Secondary uses: Cropland, hayland, pasture, recreation

Major management factors: Cropland and pasture—
water erosion, wetness; woodland—plant
competition, equipment limitations, wetness,
windthrow

7. Warba-Stuntz-Cathro

Nearly level to rolling soils on moraines

Setting

Landform and position on the landform: Shoulders, side
slopes, foot slopes, and depressions on moraines

Slope range: 0 to 12 percent

Composition

Percent of survey area: 6

Extent of components in the map unit:

Warba and similar soils—30 percent

Stuntz and similar soils—30 percent

Cathro and similar soils—25 percent

Minor soils—15 percent

Soil Properties and Qualities**Warba**

Drainage class: Well drained

Parent material: Loamy till

Surface texture: Very fine sandy loam

Stuntz

Drainage class: Somewhat poorly drained

Parent material: Loamy till

Surface texture: Silt loam

Cathro

Drainage class: Very poorly drained

Parent material: Herbaceous organic materials and the
underlying loamy sediments

Surface texture: Muck

Minor Soils

- The somewhat poorly drained Meehan soils on toe slopes and in slight depressions
- The very poorly drained Mooselake soils in depressions
- The well drained Itasca soils on side slopes and shoulders
- The very poorly drained Seelyeville soils in depressions and basins

Use and Management

Primary use: Woodland

Secondary use: Cropland

Major management factors: Cropland and pasture—
water erosion, wetness; woodland—plant
competition, equipment limitations, windthrow,
wetness

8. Nokay-Wabedo-Cathro

Nearly level to undulating soils on moraines

Setting

Landform and position on the landform: Shoulders, side
slopes, and depressions on moraines

Slope range: 0 to 6 percent

Composition

Percent of survey area: 5

Extent of components in the map unit:

Nokay and similar soils—30 percent

Wabedo and similar soils—25 percent

Cathro and similar soils—20 percent

Minor soils—25 percent

Soil Properties and Qualities**Nokay**

Drainage class: Poorly drained

Parent material: Loamy, dense till

Surface texture: Loam

Wabedo

Drainage class: Moderately well drained

Parent material: Loamy, dense till

Surface texture: Sandy loam

Cathro

Drainage class: Very poorly drained

Parent material: Herbaceous organic materials and the
underlying loamy sediments

Surface texture: Muck

Minor Soils

- The well drained Flak soils on side slopes and shoulders
- The well drained Pomroy and moderately well drained Bushville soils on side slopes, shoulders, and summits
- The somewhat poorly drained Watab soils on flats
- The very poorly drained Nokasippi soils on toe slopes and in slight depressions
- The very poorly drained Seelyeville and Greenwood soils in depressions

Use and Management

Primary use: Woodland

Secondary uses: Recreation, hayland, pasture

Major management factors: Cropland and pasture—
wetness, water erosion; woodland—plant
competition, windthrow, equipment limitations,
wetness

9. Itasca-Goodland-Warba

Nearly level to rolling soils on moraines

Setting

Landform and position on the landform: Side slopes, shoulders, and summits on moraines

Slope range: 1 to 15 percent

Composition

Percent of survey area: 5

Extent of components in the map unit:

Itasca and similar soils—35 percent

Goodland and similar soils—25 percent

Warba and similar soils—20 percent

Minor soils—20 percent

Soil Properties and Qualities

Itasca

Drainage class: Well drained

Parent material: Silty sediments over loamy till

Goodland

Drainage class: Well drained

Parent material: Silt-mantled, loamy till over sandy deposits

Warba

Drainage class: Well drained

Parent material: Loamy till

Surface texture: Very fine sandy loam

Minor Soils

- The very poorly drained Cathro and Seelyeville soils in depressions
- The somewhat poorly drained Alstad soils on foot slopes and in drainageways
- The somewhat excessively drained Cromwell soils on side slopes, shoulders, and summits

Use and Management

Primary uses: Woodland, recreation

Secondary uses: Cropland, hayland, pasture

Major management factors: Cropland and pasture—water erosion; woodland—equipment limitations

Nearly Level, Organic Soils on Flood Plains, Lake Plains, Outwash Plains, and Moraines

These very poorly drained soils formed in organic soil material derived from decaying reed-sedge, sphagnum moss, and woody vegetation.

Some areas of these soils are heavily forested, some areas support only stunted trees, and other areas are not forested. Wetness is the major management concern.

These soils make up about 6 percent of the survey area.

10. Seelyeville-Mooselake-Greenwood

Nearly level, very poorly drained soils in depressions and drainageways on moraines, lake plains, and outwash plains

Setting

Landform and position on the landform: Moraines, till-floored lake plains, outwash plains

Slope range: 0 to 2 percent

Composition

Percent of survey area: 6

Extent of components in the map unit:

Seelyeville and similar soils—35 percent

Mooselake and similar soils—30 percent

Greenwood and similar soils—20 percent

Minor soils—15 percent

Soil Properties and Qualities

Seelyeville

Drainage class: Very poorly drained

Parent material: Herbaceous organic materials

Surface texture: Muck

Mooselake

Drainage class: Very poorly drained

Parent material: Woody organic materials

Surface texture: Mucky peat

Greenwood

Drainage class: Very poorly drained

Parent material: Herbaceous organic materials

Surface texture: Peat

Minor Soils

- The very poorly drained Cathro and Markey soils in shallow depressions and drainageways
- The very poorly drained Roscommon soils on toe slopes and in shallow drainageways
- The excessively drained Zimmerman soils on summits and side slopes
- The poorly drained Spooner soils on toe slopes and in shallow drainageways
- The somewhat poorly drained Stuntz soils on toe slopes

Use and Management

Primary use: Wetlands

Secondary uses: Woodland, recreation

Major management factors: Cropland and pasture—wetness; woodland—wetness, seedling mortality, equipment limitations, windthrow

Nearly Level to Sloping, Loamy, Sandy Over Loamy, and Organic Soils on Drumlins and Moraines

These well drained, moderately well drained, poorly

drained, and very poorly drained soils formed in dense, loamy glacial till; in sandy sediments over dense, loamy till; and in organic soil material. The soils in upland areas formed under mixed pine-hardwood forests, and those in the lowland areas formed under reed-sedge vegetation.

Most areas of these soils are used as cropland, hayland, or pasture. Some areas are forested. Wind erosion, water erosion, droughtiness, and wetness are the major management concerns.

These soils make up about 16 percent of the survey area.

11. Wabedo-Flak-Nokay

Nearly level to sloping soils on drumlins and moraines

Setting

Landform and position on the landform: Shoulder slopes, side slopes, toe slopes, and flats on drumlins and moraines (fig. 3)

Slope range: 0 to 15 percent

Composition

Percent of survey area: 8

Extent of components in the map unit:

Wabedo and similar soils—30 percent

Flak and similar soils—25 percent

Nokay and similar soils—20 percent

Minor soils—25 percent

Soil Properties and Qualities

Wabedo

Drainage class: Moderately well drained

Parent material: Loamy, dense till

Surface texture: Sandy loam

Flak

Drainage class: Well drained

Parent material: Loamy, dense till

Surface texture: Sandy loam

Nokay

Drainage class: Poorly drained

Parent material: Loamy, dense till

Surface texture: Loam

Minor Soils

- The well drained Pomroy and moderately well drained Bushville soils on side slopes, shoulder slopes, and summits
- The moderately well drained Friendship soils on the lower side slopes
- The somewhat poorly drained Meehan soils on toe slopes
- The very poorly drained Seelyeville and Cathro soils on the lower lying flats or in depressions

- The poorly drained Watab soils on toe slopes and in slight depressions

Use and Management

Primary use: Crops

Secondary uses: Woodland, hayland, pasture

Major management factors: Cropland and pasture—water erosion, wetness; woodland—plant competition, windthrow, equipment limitations, wetness

12. Huntersville-Staples-Cathro

Nearly level to sloping soils on drumlins

Setting

Landform and position on the landform: Summits, side slopes, foot slopes, and depressions on drumlins

Slope range: 0 to 6 percent

Composition

Percent of survey area: 8

Extent of components in the map unit:

Huntersville and similar soils—30 percent

Staples and similar soils—25 percent

Cathro and similar soils—25 percent

Minor soils—20 percent

Soil Properties and Qualities

Huntersville

Drainage class: Moderately well drained

Parent material: Sandy mantle and the underlying loamy, dense till

Surface texture: Loamy sand

Staples

Drainage class: Poorly drained

Parent material: Sandy mantle and the underlying loamy, dense till

Surface texture: Loamy sand

Cathro

Drainage class: Very poorly drained

Parent material: Herbaceous organic materials and the underlying loamy sediments

Surface texture: Muck

Minor Soils

- The well drained Redeye soils on side slopes, shoulder slopes, and summits
- The moderately well drained Friendship soils on foot slopes
- The moderately well drained Blowers soils on side slopes and summits
- The somewhat poorly drained Paddock soils on foot slopes and toe slopes
- The very poorly drained Seelyeville and Markey soils

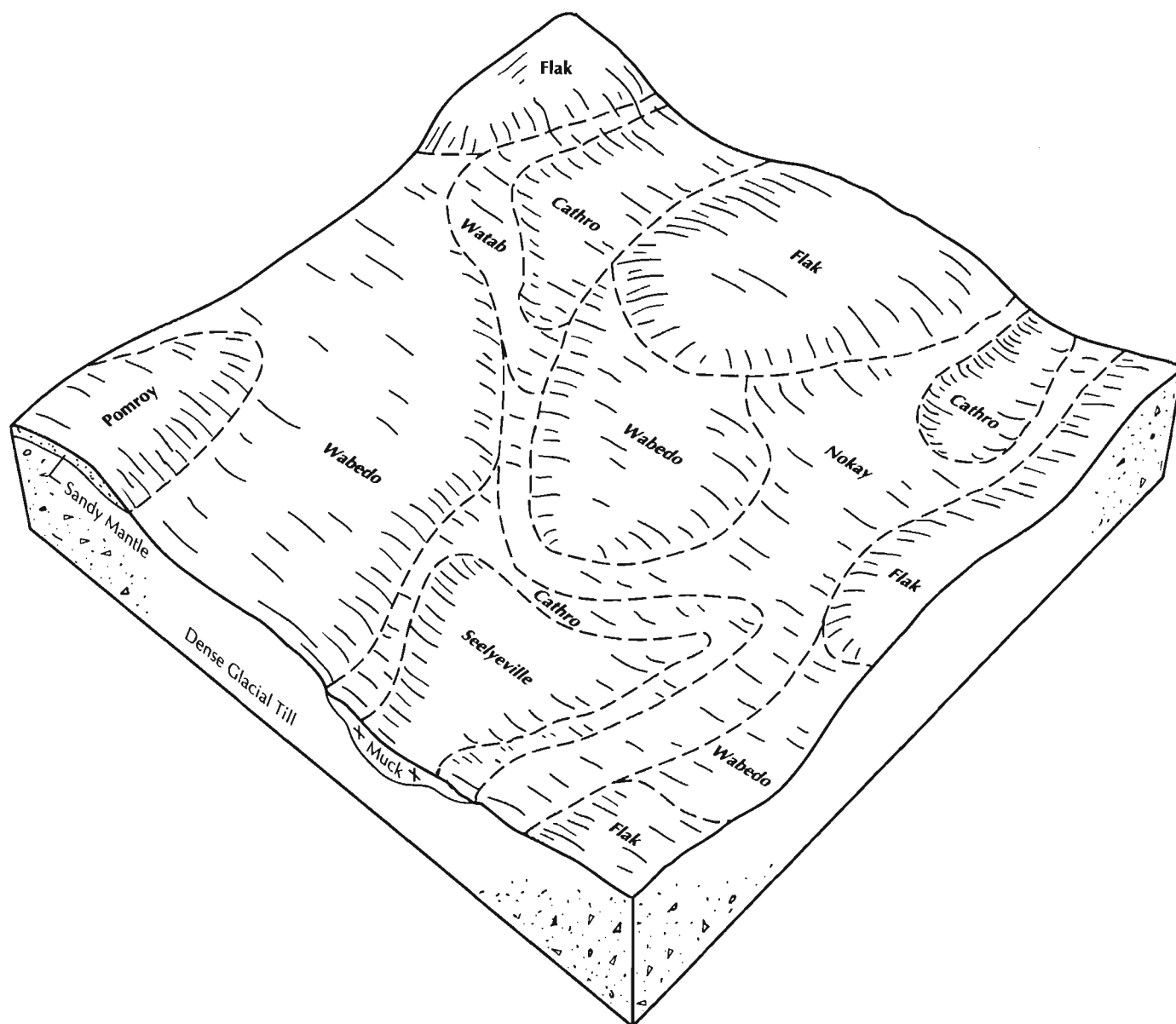


Figure 3.—Typical pattern of soils and parent material in the Wabedo-Flak-Nokay general soil map unit.

in depressions and drainageways

Use and Management

Primary use: Cropland

Secondary uses: Hayland, pasture, woodland

Major management factors: Cropland and pasture—wind erosion, droughtiness, wetness; woodland—plant competition, seedling mortality, equipment limitations, windthrow

Nearly Level to Steep, Loamy, Sandy, and Sandy Over Loamy Soils on Terminal Moraines and Outwash Plains

These excessively drained, well drained, and somewhat poorly drained soils formed in loamy glacial till, in sandy sediments over loamy glacial till, and in sandy sediments. They formed under mixed pine-hardwood forests.

Most areas of these soils are forested. Some areas are used as cropland, hayland, or pasture. Plant competition, equipment limitations, and seedling mortality are the major management concerns affecting woodland.

These soils make up about 30 percent of the survey area.

13. Warba-Menahga-Stuntz

Nearly level to steep soils on terminal moraines

Setting

Landform and position on the landform: Summits, side slopes, toe slopes, and drainageways on terminal moraines

Slope range: 0 to 25 percent

Composition

Percent of survey area: 20

Extent of components in the map unit:

Warba and similar soils—25 percent

Menahga and similar soils—25 percent

Stuntz and similar soils—20 percent

Minor soils—30 percent

Soil Properties and Qualities

Warba

Drainage class: Well drained

Parent material: Loamy till

Surface texture: Very fine sandy loam

Menahga

Drainage class: Excessively drained

Parent material: Outwash

Surface texture: Loamy sand

Stuntz

Drainage class: Somewhat poorly drained

Parent material: Loamy till

Surface texture: Silt loam

Minor Soils

- The well drained Itasca soils on side slopes, shoulder slopes, and summits
- The excessively drained Mahtomedi soils on side slopes, shoulder slopes, and summits
- The very poorly drained Greenwood and Mooselake soils in depressions

Use and Management

Primary use: Woodland

Secondary uses: Recreation, hayland, cropland

Major management factors: Cropland and pasture—water erosion, wind erosion, droughtiness, wetness,

slope; woodland—plant competition, equipment limitations, windthrow, seedling mortality, wetness

14. Demontreville-Menahga-Cushing

Gently sloping to steep soils on terminal moraines

Setting

Landform and position on the landform: Terminal moraines

Slope range: 1 to 40 percent

Composition

Percent of survey area: 10

Extent of components in the map unit:

Demontreville and similar soils—30 percent

Menahga and similar soils—20 percent

Cushing and similar soils—20 percent

Minor soils—30 percent

Soil Properties and Qualities

Demontreville

Drainage class: Well drained

Parent material: Sandy mantle and the underlying loamy till

Surface texture: Loamy sand

Menahga

Drainage class: Excessively drained

Parent material: Outwash

Surface texture: Loamy sand

Cushing

Drainage class: Well drained

Parent material: Loamy till

Surface texture: Loam

Minor Soils

- The excessively drained Mahtomedi soils on side slopes, shoulder slopes, and summits
- The somewhat poorly drained Alstad soils on foot slopes
- The very poorly drained Seelyeville and Cathro soils in depressions and drainageways
- The somewhat poorly drained Watab soils on foot slopes and in slight depressions

Use and Management

Primary use: Woodland

Secondary uses: Recreation, pasture, hayland

Major management factors: Cropland and pasture—droughtiness, water erosion, wind erosion, slope; woodland—plant competition, seedling mortality, equipment limitations, slope

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Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Menahga loamy sand, 0 to 3 percent slopes, is a phase of the Menahga series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Demontreville-Mahtomedi-Cushing

complex, 2 to 8 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Hiwood-Zimmerman association, nearly level to hilly, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. The map unit Mooselake and Lupton soils is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

This technical publication includes suggested management practices that are intended to increase crop production, reduce the hazards of wind erosion and water erosion, and help to overcome wetness limitations. Over a period of time, some or all of these conservation practices may or may not be in accordance with Federal, State, or local laws or with agency rules and guides.

Descriptions of Soils Outside the Chippewa National Forest

7A—Hubbard loamy sand, 0 to 3 percent slopes

Composition

Hubbard soil and similar soils: 90 to 98 percent
Contrasting inclusions: 2 to 10 percent

Setting

Landform and position on the landform: Plane or slightly convex rises on outwash plains and valley trains
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 5 to 200 acres

Typical Profile

0 to 10 inches—black loamy sand
10 to 16 inches—very dark brown loamy sand
16 to 24 inches—dark brown loamy sand
24 to 34 inches—yellowish brown sand
34 to 44 inches—dark yellowish brown sand
44 to 60 inches—dark brown sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderate or high
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils on toe slopes adjacent to drainageways
- The excessively drained Menahga soils, which do not have a thick, dark surface layer; in landscape positions similar to those of the Hubbard soil
- The somewhat poorly drained Meehan soils in shallow depressions

Similar soils:

- Soils that have a surface layer of sand
- Soils that contain 15 to 25 percent gravel
- Soils that have a dark surface layer less than 10 inches thick
- Soils in areas that have slopes of 3 to 8 percent

Use and Management

Cropland, pasture, and forage

- Major management factors:* Available water capacity, wind erosion
- The major crops are oats, corn for silage, and forage.

- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are red pine and jack pine. Species of limited extent are eastern white pine, white spruce, and bur oak.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.

Interpretive Groups

Land capability classification: 4s
Woodland ordination symbol: 6A
Windbreak suitability group: 7

7B—Hubbard loamy sand, 3 to 8 percent slopes

Composition

Hubbard soil and similar soils: 92 to 98 percent
Contrasting inclusions: 2 to 8 percent

Setting

Landform and position on the landform: Shoulder slopes and side slopes on outwash plains and valley trains
Shape of areas: Moderately long and moderately wide with smooth edges
Size of areas: 5 to 200 acres

Typical Profile

0 to 15 inches—very dark brown loamy sand
15 to 19 inches—dark brown loamy sand
19 to 45 inches—dark yellowish brown sand
45 to 60 inches—yellowish brown sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderate or high
Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The excessively drained Menahga soils, which do not have a thick, dark surface layer; in landscape positions similar to those of the Hubbard soil
- The somewhat poorly drained Meehan soils in shallow depressions
- The moderately well drained Friendship soils on nearly level slopes

Similar soils:

- Soils that have a surface layer of sand
- Soils that contain 15 to 25 percent gravel
- Soils that have a dark surface layer less than 10 inches thick
- Soils in areas that have slopes of 0 to 3 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are red pine and jack pine. Species of limited extent are eastern white pine, white spruce, and bur oak.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6A

Windbreak suitability group: 7

48—Hiwood loamy fine sand

Composition

Hiwood soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Slightly convex swells on outwash plains and till-floored glacial lake plains

Slope range: 0 to 2 percent

Shape of areas: Elongated or moderately long and moderately wide with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

0 to 2 inches—very dark brown loamy fine sand

2 to 5 inches—very dark grayish brown loamy fine sand

5 to 9 inches—dark brown loamy fine sand

9 to 14 inches—dark yellowish brown loamy fine sand

14 to 30 inches—yellowish brown, mottled loamy fine sand

30 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:

- The excessively drained Zimmerman soils in the more sloping areas
- The very poorly drained Roscommon soils in swales
- Some areas of somewhat poorly drained soils that have a water table closer to the surface than that in the Hiwood soil

Similar soils:

- Soils that have loamy bands within the profile
- Soils that have thin lenses of gravelly material
- Soils that have thin lenses of silty sediments

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats and forage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The seasonal high water table provides supplemental moisture for plants.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications

of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine and jack pine. Species of limited extent are eastern white pine and white spruce.
- The soil is usually wet from fall to spring and can be wet during other periods. Equipment should be used only during dry periods in summer and during winter when the snow cover is adequate.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 8W

Windbreak suitability group: 7

82B—Redeye loamy sand, 1 to 6 percent slopes

Composition

Redeye soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane and convex areas on drumlins

Shape of areas: Elongated

Size of areas: 5 to 75 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 18 inches—brown sand

18 to 26 inches—yellowish brown loamy sand

26 to 38 inches—yellowish brown sandy loam

38 to 52 inches—dark yellowish brown sandy loam

52 to 60 inches—light yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 52 inches

Inclusions

Contrasting inclusions:

- Very poorly drained soils in strongly concave areas on the lower parts of the landscape
- The somewhat poorly drained Meehan soils in nearly level areas or on the lower parts of the landscape
- The somewhat poorly drained Paddock soils in nearly level areas or on the lower parts of the landscape
- The poorly drained Roscommon soils on the lower parts of the landscape
- The poorly drained Staples soils on the lower parts of the landscape and in slightly concave areas

Similar soils:

- Soils that have many cobbles and stones on the surface
- Soils that are moderately well drained
- Soils in which the sandy upper part is more than 40 inches or less than 20 inches thick
- Soils that have a surface layer of sand, fine sand, or loamy fine sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur oak, bigtooth aspen, and northern red oak.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 6S

Windbreak suitability group: 5

82C—Redeye loamy sand, 6 to 12 percent slopes

Composition

Redeye soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex areas on convex side slopes and shoulder slopes on drumlins

Shape of areas: Elongated

Size of areas: 4 to 60 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand

4 to 7 inches—dark brown sand

7 to 31 inches—yellowish brown and brown sand

31 to 48 inches—dark yellowish brown and brown sandy loam and loamy sand

48 to 60 inches—yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 48 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Blowers soils, which are sandy loam throughout; in the less sloping areas
- The moderately well drained Huntersville soils in the less sloping areas

- Poorly drained, sandy and gravelly soils on toe slopes adjacent to drainageways

Similar soils:

- Soils in which the sandy mantle is slightly thicker or thinner
- Soils in areas that have slopes of 1 to 6 percent
- Soils that have a surface soil of sandy loam
- Small areas of soils that contain sand or sand and gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur oak, bigtooth aspen, and northern red oak.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 6S

Windbreak suitability group: 5

119B—Pomroy loamy sand, 3 to 8 percent slopes

Composition

Pomroy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane to convex side slopes, shoulder slopes, and summits on drumlins

Shape of areas: Ovoid or moderately long and moderately wide with smooth edges

Size of areas: 5 to 60 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand

4 to 14 inches—yellowish brown loamy fine sand

14 to 24 inches—brown fine sand

24 to 31 inches—brown, mottled sandy loam

31 to 42 inches—dark brown, mottled sandy loam

42 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 42 inches

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Watab soils on the lower lying slopes
- The moderately well drained Wabedo soils, which do not have a sandy mantle; on the lower lying slopes
- The well drained Flak soils, which do not have a sandy mantle
- The moderately well drained Bushville soils on the lower lying slopes

Similar soils:

- Soils that have a thinner or thicker sandy mantle
- Soils in areas that have slopes of 0 to 3 percent or 8 to 15 percent
- Soils that have a surface layer of sandy loam, loamy fine sand, or fine sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.

- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine, jack pine, and northern red oak. Species of limited extent are eastern white pine and white spruce.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Using specialized or containerized seedlings also reduces the seedling mortality rate.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 4S

Windbreak suitability group: 5

119C—Pomroy loamy sand, 8 to 15 percent slopes

Composition

Pomroy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on drumlins

Shape of areas: Elongated or circular

Size of areas: 5 to 50 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 7 inches—brown sand

7 to 34 inches—yellowish brown sand

34 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 40 inches

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Watab soils on the lower lying slopes
- The excessively drained Menahga soils on knobs

Similar soils:

- Soils in areas that have slopes of 3 to 8 percent
- Soils that have a thinner or thicker sandy mantle
- Soils that have a surface layer of loamy fine sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine, jack pine, and northern red oak. Species of limited extent are eastern white pine and white spruce.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Using specialized or containerized seedlings also reduces the seedling mortality rate.

- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 4S

Windbreak suitability group: 5

126B—Graycalm loamy sand, 1 to 8 percent slopes

Composition

Graycalm soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains and moraines

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

0 to 8 inches—dark brown loamy sand

8 to 16 inches—light yellowish brown sand

16 to 52 inches—light yellowish brown sand, brownish yellow sand, yellowish brown sand, and thin bands of dark brown loamy sand

52 to 60 inches—brownish yellow sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville soils, which have more clay in the subsoil and underlying material than the Graycalm soil; on isolated swells
- The moderately well drained Friendship soils, which do not have bands in the subsoil; in the lower landscape positions
- The somewhat poorly drained Meehan soils in the nearly level, lower lying areas

Similar soils:

- Soils that do not have thin bands of finer textured material
- Soils in which the total accumulation of thin bands of finer textured material is greater than 6 inches

- Soils that have more clay in the surface layer
- Soils that have layers of finer sands
- Soils that have layers containing more than 15 percent gravel
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats and corn for silage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are red pine, jack pine, eastern white pine, and quaking aspen. Species of limited extent are white spruce, paper birch, northern red oak, and balsam fir.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 7A

Windbreak suitability group: 7

126C—Graycalm loamy sand, 8 to 15 percent slopes

Composition

Graycalm soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and side slopes on outwash plains and moraines

Shape of areas: Moderately long and narrow with curvilinear edges

Size of areas: 10 to 50 acres

Typical Profile

0 to 4 inches—black loamy sand

4 to 11 inches—yellowish brown sand

11 to 27 inches—brown sand

27 to 50 inches—light yellowish brown and brown sand and thin bands of strong brown loamy sand

50 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville soils, which have more clay in the subsoil and underlying material than the Graycalm soil; on the lower lying slopes
- The moderately well drained Friendship soils, which do not have bands in the subsoil; in the lower landscape positions
- The somewhat poorly drained Meehan soils in the nearly level, lower lying areas

Similar soils:

- Soils that do not have thin bands of finer textured material
- Soils in which the total accumulation of thin bands of finer textured material is more than 6 inches
- Soils that are fine sand
- Soils that have layers containing more than 15 percent gravel
- Soils in areas that have slopes of 1 to 8 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazards of wind erosion and water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are red pine, jack pine,

eastern white pine, and quaking aspen. Species of limited extent are white spruce, paper birch, northern red oak, and balsam fir.

- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 7A

Windbreak suitability group: 7

139B—Huntersville loamy fine sand, 1 to 6 percent slopes

Composition

Huntersville soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane, slightly concave, or convex areas on drumlins

Shape of areas: Oblong

Size of areas: 5 to 60 acres

Typical Profile

0 to 7 inches—very dark gray loamy fine sand

7 to 12 inches—dark brown loamy sand

12 to 24 inches—yellowish brown cobbly loamy sand

24 to 60 inches—yellowish brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 2.5 to 4.0 feet

Special characteristics: A root-restricting layer at a depth of 40 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils, which are sandy throughout; in landscape positions similar to those of the Huntersville soil
- The poorly drained Staples soils on nearly level, concave slopes and in drainageways
- The very poorly drained Runeberg soils, which are sandy loam throughout; in drainageways
- The somewhat poorly drained Paddock soils on foot slopes

Similar soils:

- Soils in which the sandy mantle is slightly thicker or thinner
- Soils that are well drained
- A few areas of soils that have steeper slopes
- Soils that have a surface layer of loamy fine sand, sand, or sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur oak, bigtooth aspen, and northern red oak.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 6L

Windbreak suitability group: 5

142—Nokay loam

Composition

Nokay soil and similar soils: 85 to 98 percent

Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Concave toe slopes, flats, and drainageways on drumlins and ground moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 5 to 200 acres

Typical Profile

0 to 5 inches—black loam

5 to 17 inches—grayish brown, mottled sandy loam

17 to 32 inches—brown, mottled sandy loam

32 to 44 inches—dark brown, mottled loamy coarse sand

44 to 60 inches—brown, mottled loamy coarse sand

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 1.0 to 2.5 feet

Special characteristics: A root-restricting layer at a depth of 44 inches

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in wet depressions and in drainageways
- The well drained Flak soils in the more sloping areas at the higher elevations
- The moderately well drained Wabedo soils on rises and in slightly elevated areas

Similar soils:

- Soils that have silty or sandy layers above the underlying material
- Soils that have a surface layer of fine sandy loam or sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- The major crops are oats and corn for silage.
- Wetness limits the choice of plants, restricts the period of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.
- The underlying dense till restricts the growth of deep-rooted plants.
- Compaction and poor tilth can be avoided by restricting use during wet periods.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen, northern red oak, sugar maple, and American basswood.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- After the trees are cut, plant competition can be expected to prevent natural regeneration unless precautionary measures are applied.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Because of the dense layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 2w

Woodland ordination symbol: 5W

Windbreak suitability group: 1

144B—Flak sandy loam, 3 to 8 percent slopes

Composition

Flak soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and convex side slopes on moraines and drumlins

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 4 inches—very dark grayish brown sandy loam

4 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 30 inches

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The poorly drained Nokay soils on flats and the upper parts of drainageways
- The moderately well drained Wabedo soils in the lower landscape positions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- The underlying dense till restricts the growth of deep-rooted plants.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are northern red oak, quaking aspen, and American basswood. Species of limited extent are American elm, white oak, and jack pine.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions, generally during dry periods, help to prevent surface compaction.
- Equipment use is commonly restricted for a short period in the spring and after periods of excessive precipitation.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 3A

Windbreak suitability group: 4F

144C—Flak sandy loam, 8 to 15 percent slopes

Composition

Flak soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Knolls and convex side slopes on moraines and drumlins

Shape of areas: Elongated or short and narrow with curvilinear edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 6 inches—very dark brown sandy loam

6 to 14 inches—brown sandy loam

14 to 26 inches—dark yellowish brown sandy loam

26 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 41 inches

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The poorly drained Nokay soils on flats, in swales, and in shallow drainageways
- The moderately well drained Wabedo soils on the lower slopes

Similar soils:

- A few areas of soils that have more sand in the surface layer
- Soils that have more clay in the subsoil
- Soils in areas that have slopes of 3 to 8 percent
- Soils that have a surface layer of fine sandy loam
- Soils that have boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- The underlying dense till restricts the growth of deep-rooted plants.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are northern red oak, quaking aspen, and American basswood. Species of limited extent are American elm, white oak, and jack pine.
- Because of the firm layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Erosion results from the concentration of runoff on logging roads, in the tracks of wheeled equipment, and on landings.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.
- Equipment use is commonly restricted for a short period in the spring and after periods of excessive precipitation.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 3A

Windbreak suitability group: 4F

146B—Wabedo sandy loam, 1 to 6 percent slopes

Composition

Wabedo soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and convex side slopes on drumlins and ground moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 5 to 100 acres

Typical Profile

- 0 to 5 inches—very dark brown sandy loam
- 5 to 8 inches—dark brown sandy loam
- 8 to 15 inches—dark brown and yellowish brown, mottled sandy loam
- 15 to 27 inches—dark yellowish brown and dark brown, mottled sandy loam
- 27 to 47 inches—dark brown, mottled sandy loam

47 to 60 inches—strong brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Moderately low to high

Surface runoff: Slow

Depth to the water table: 1.5 to 2.5 feet

Special characteristics: A root-restricting layer at a depth of 47 inches

Inclusions

Contrasting inclusions:

- The poorly drained Nokay soils in the lower lying positions
- Very poorly drained organic soils in depressions
- The well drained Flak soils in the slightly higher landscape positions

Similar soils:

- Soils that have a surface layer of fine sandy loam or gravelly sandy loam
- Soils that have sandy subhorizons
- Soils that have large cobbles and boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- The underlying dense till restricts the growth of deep-rooted plants.
- Compaction and poor tilth can be avoided by restricting use during wet periods.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are northern red oak, quaking aspen, bur oak, balsam fir, and American basswood. Species of limited extent are white spruce and eastern white pine.
- Because of the firm layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or

artificial reestablishment of trees.

- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- The use of equipment is restricted in the spring and in other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 4W

Windbreak suitability group: 4F

147—Spooner very fine sandy loam

Composition

Spooner soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane or very slightly concave or convex flats on lake plains

Slope range: 0 to 2 percent

Shape of areas: Elongated or moderately long and narrow with curvilinear edges

Size of areas: 5 to 60 acres

Typical Profile

0 to 6 inches—very dark gray very fine sandy loam

6 to 14 inches—grayish brown very fine sandy loam

14 to 22 inches—dark grayish brown, mottled silt loam

22 to 60 inches—light brownish gray, mottled very fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Moderate

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Baudette soils in the more sloping areas
- The very poorly drained, organic Cathro soils in depressions and drainageways
- The somewhat poorly drained Sandwich soils, which have a sandy mantle; in landscape positions similar to those of the Spooner soil

Similar soils:

- Soils that formed in loamy till

- Soils that have sandy subhorizons
- Soils that have a surface layer of silt loam, silty clay loam, or fine sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, erosion

- The major crops are oats and spring wheat.
- Wetness limits the choice of plants, limits the production of deep-rooted crops, and increases the risk of winterkill.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotating grazing, mowing and clipping, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of erosion.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen, paper birch, and black ash. Species of limited extent are white spruce and balsam fir.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- When the soil is wet, unsurfaced roads and landings are slippery and ruts form easily.
- If openings are made in the canopy, invading plants can prevent the natural or artificial regeneration of trees.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 4w

Woodland ordination symbol: 7W

Windbreak suitability group: 2

158B—Zimmerman fine sand, 1 to 8 percent slopes

Composition

Zimmerman soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Summits and

side slopes on outwash plains

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 250 acres

Typical Profile

1 inch to 0—black forest litter

0 to 1 inch—very dark grayish brown fine sand

1 to 4 inches—dark gray fine sand

4 to 9 inches—dark yellowish brown fine sand

9 to 16 inches—light yellowish brown fine sand

16 to 26 inches—yellowish brown fine sand

26 to 41 inches—pale brown fine sand

41 to 60 inches—pale brown fine sand and thin bands of brown loamy fine sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Hiwood soils in the slightly lower landscape positions
- The very poorly drained Roscommon soils in depressions and drainageways
- Very poorly drained organic soils in depressions
- Somewhat poorly drained soils in the lower landscape positions

Similar soils:

- Soils that have sandy layers of predominantly coarser sands
- Soils that have a surface layer of sand or loamy sand
- A few areas of soils that have layers of very fine sand
- Soils that are well drained
- Soils that do not have brown bands in the subsoil
- Soils that have loamy layers in the underlying material
- A few areas of soils that have brown bands closer to the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field

windbreaks, and using minimum tillage reduce the hazard of wind erosion.

- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, jack pine, quaking aspen, and paper birch. Species of limited extent are balsam fir, northern red oak, eastern white pine, and white spruce.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 8S

Windbreak suitability group: 7

167B—Baudette silt loam, 1 to 6 percent slopes

Composition

Baudette soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Slightly convex or plane slopes on glacial lake plains

Shape of areas: Moderately long and moderately wide with smooth edges or elongated

Size of areas: 5 to 75 acres

Typical Profile

0 to 3 inches—black silt loam

3 to 10 inches—pale brown, mottled silt loam

10 to 13 inches—dark yellowish brown silty clay loam

13 to 17 inches—yellowish brown silty clay loam

17 to 26 inches—brown, mottled silty clay loam

26 to 32 inches—dark grayish brown, mottled silt loam

32 to 60 inches—light olive brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Moderate

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:

- The poorly drained Spooner soils on the lower lying slopes and in depressions
- The moderately well drained Friendship soils, which are sandy throughout; in landscape positions similar to those of the Baudette soil
- The somewhat poorly drained Stuntz soils, which formed in till; on the lower lying slopes

Similar soils:

- Soils that have a surface layer of fine sandy loam, loam, very fine sandy loam, or silty clay loam
- Soils that have a sandy mantle over the silty sediments

Use and Management

Cropland, pasture, and forage

Major management factors: Water erosion

- The major crops are oats, corn for silage, spring wheat, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen and balsam fir. Species of limited extent are paper birch, black ash, American elm, white spruce, bur oak, and American basswood.
- If the overstory is removed, competition from unwanted species may be severe.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- Using wheeled and tracked equipment when the soil is wet produces ruts and increases compaction.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 7L

Windbreak suitability group: 3

202—Meehan loamy sand

Composition

Meehan soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Nearly level or slightly concave slopes on outwash plains

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 7 inches—very dark grayish brown loamy sand

7 to 9 inches—dark brown, mottled sand

9 to 18 inches—pale brown, mottled sand

18 to 24 inches—strong brown, mottled sand

24 to 60 inches—grayish brown, mottled sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low to moderate

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils, which have mottles at a lower depth than those in the Meehan soil; in the higher landscape positions
- The very poorly drained Roscommon soils in drainageways and shallow depressions

Similar soils:

- Soils that have a surface layer of sand or loamy fine sand
- Soils that contain more fine sand
- Soils that have loamy subhorizons

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Wetness and droughtiness limit the choice of plants.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of wind erosion.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are jack pine, red pine, and quaking aspen. Species of limited extent are paper birch, balsam fir, and eastern white pine.
- The soil is usually wet from fall to spring and can be wet during other periods. Equipment should be used only during dry periods in summer and during winter when the snow cover is adequate.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- After the trees are cut, plant competition can be expected to prevent natural regeneration unless precautionary measures are applied.

Interpretive Groups

Land capability classification: 4w

Woodland ordination symbol: 6W

Windbreak suitability group: 1

204B—Cushing loam, 2 to 8 percent slopes

Composition

Cushing soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 2 inches—black loam

2 to 10 inches—grayish brown loam

10 to 20 inches—dark brown and brown loam

20 to 31 inches—brown loam

31 to 44 inches—yellowish brown sandy loam

44 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils on the

lower lying, nearly level slopes and in swales

- Very poorly drained organic soils in small closed depressions
- The excessively drained Mahtomedi soils, which are sandy and gravelly throughout; on knobs and shoulder slopes

Similar soils:

- Soils that have a sandy subsurface layer
- Small areas of soils that have more clay in the subsoil and underlying material
- Moderately well drained soils in areas that have slopes of less than 2 percent
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a surface layer of very fine sandy loam, fine sandy loam, sandy loam, or silt loam

Use and Management

Cropland, pasture, and forage

Major management factors: Water erosion

- The major crops are oats, corn for silage, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are balsam fir, paper birch, and sugar maple.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Competition from undesirable species can be expected to prevent natural or planted regeneration unless precautionary measures are taken.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 6L

Windbreak suitability group: 3

204C—Cushing loam, 8 to 15 percent slopes**Composition**

Cushing soil and similar soils: 90 to 97 percent

Contrasting inclusions: 3 to 10 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 150 acres

Typical Profile

0 to 5 inches—very dark grayish brown loam

5 to 17 inches—brown sandy loam

17 to 25 inches—dark brown loam and brown sandy loam

25 to 37 inches—dark brown clay loam

37 to 49 inches—brown clay loam

49 to 60 inches—dark brown sandy clay loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils on the lower lying, nearly level slopes and in swales
- Very poorly drained organic soils in small depressions
- The well drained Demontreville soils, which have a sandy mantle; in the lower landscape positions
- The excessively drained Mahtomedi soils, which are sandy and gravelly throughout; on knobs and shoulder slopes
- The excessively drained Menahga soils on moraines, which are sandy throughout; on knobs

Similar soils:

- Soils that have a sandy subsurface layer
- Soils that have a surface layer of fine sandy loam, sandy loam, or silt loam
- Small areas of soils that have slightly more clay in the subsoil and underlying material
- Soils in areas that have slopes of 2 to 8 percent or 15 to 30 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Water erosion

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, farming across the slope, and installing terraces, diversions, and grassed waterways reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are balsam fir, paper birch, and sugar maple.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Competition from undesirable species can be expected to prevent natural or planted regeneration unless precautionary measures are taken.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily.
- Erosion results from the concentration of runoff on logging roads, in the tracks of wheeled equipment, and on landings.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 6L

Windbreak suitability group: 3

204E—Cushing loam, 15 to 30 percent slopes**Composition**

Cushing soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Elongated

Size of areas: 5 to 30 acres

Typical Profile

0 to 3 inches—black loam

3 to 20 inches—pale brown fine sandy loam

- 20 to 30 inches—pale brown fine sandy loam and brown loam
- 30 to 38 inches—brown loam
- 38 to 60 inches—brown fine sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Medium or rapid

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils in swales and depressions
- Poorly drained mineral soils on toe slopes and in depressions
- Very poorly drained organic soils in depressions

Similar soils:

- Soils that have a surface layer of very fine sandy loam or fine sandy loam
- Soils that have sandy subsurface horizons
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Pasture and forage

Major management factors: Water erosion

- Most areas are used for pasture or hay.
- Rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion

- The principal tree species are quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are balsam fir, paper birch, and sugar maple.
- Plant competition can be expected to prevent natural or planted regeneration unless precautionary measures are taken.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.
- Because of the slope, the number of suitable landing sites is minimal. Preferred locations for landings are on the nearly level parts of this unit.
- Ruts form easily if skidders are used when the soil is

wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.

- Special care is needed in laying out roads and landings and in operating the equipment. Roads can be designed so that they conform to the topography. The grade should be kept as low as possible.

Interpretive Groups

Land capability classification: 6e

Woodland ordination symbol: 6R

Windbreak suitability group: 3

217—Nokasippi loamy fine sand

Composition

Nokasippi soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Nearly level or concave drainageways on drumlins and moraines

Slope range: 0 to 1 percent

Shape of areas: Moderately long and narrow with curvilinear edges

Size of areas: 5 to 80 acres

Typical Profile

4 inches to 0—black mucky peat

0 to 10 inches—black loamy fine sand

10 to 21 inches—gray loamy sand

21 to 32 inches—grayish brown loamy sand

32 to 41 inches—grayish brown, mottled sandy loam

41 to 60 inches—dark brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: High

Surface runoff: Slow

Seasonal high water table: 1 foot above to 1 foot below the surface

Special characteristics: A root-restricting layer at a depth of 49 inches

Inclusions

Contrasting inclusions:

- The poorly drained Nokay soils on convex toe slopes and flats
- Very poorly drained organic soils in depressions
- The somewhat poorly drained Watab soils, which have a sandy mantle over sandy loam till

Similar soils:

- Soils that have a surface layer of sand or loamy sand

Use and Management

Pasture and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- Wetness limits the choice of plants and the period of grazing.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rotating grazing, mowing and clipping, and controlling weeds help to maintain the quality and quantity of forage.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

218—Watab loamy sand

Composition

Watab soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane slopes, depressions, and drainageways on drumlins and ground moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 5 inches—dark brown loamy sand

5 to 12 inches—dark grayish brown, mottled loamy sand

12 to 21 inches—dark brown, mottled loamy sand

21 to 30 inches—yellowish brown, mottled loamy sand

30 to 41 inches—strong brown, mottled fine sandy loam

41 to 60 inches—strong brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 0.5 foot to 2.0 feet

Special characteristics: A root-restricting layer at a depth of 41 inches

Inclusions

Contrasting inclusions:

- The very poorly drained Nokasippi soils in the

lower positions on the landscape

Similar soils:

- Soils that have a surface layer of sand or sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, seasonal high water table

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Wetness and droughtiness limit the choice of plants, restrict the period of grazing, limit the production of deep-rooted crops, and increase the risk of winterkill.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and American basswood. Species of limited extent are white spruce and sugar maple.
- If the overstory is removed, competition from undesirable species may be severe.
- If trees are planted, site preparation by mechanical or chemical means is needed to control competing vegetation.
- Droughtiness of the surface layer increases the seedling mortality rate. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- Because of the dense layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 3w

Woodland ordination symbol: 6W

Windbreak suitability group: 2

240A—Warba very fine sandy loam, 1 to 3 percent slopes, moderately wet

Composition

Warba soil and similar soils: 85 to 98 percent

Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Plane to convex side slopes on moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 200 acres

Typical Profile

0 to 1 inch—black very fine sandy loam

1 to 3 inches—dark grayish brown fine sandy loam

3 to 9 inches—yellowish brown fine sandy loam

9 to 14 inches—light brownish gray fine sandy loam

14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam

18 to 28 inches—olive brown loam

28 to 36 inches—olive brown clay loam

36 to 40 inches—light olive brown clay loam

40 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 3.5 to 6.0 feet

Special characteristics: A perched water table may form in the less sloping areas for short periods.

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the Warba soil
- The somewhat poorly drained Stuntz soils in the lower lying areas or in swales

Similar soils:

- Soils that have a surface layer of sandy loam or fine sandy loam
- Soils that have a sandy subsurface layer
- Soils that are moderately well drained
- Soils that have more clay in the subsoil
- Soils in areas that have slopes of 3 to 8 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, American basswood, sugar maple, bigtooth aspen, northern red oak, and red pine. Species of limited extent are paper birch, balsam fir, eastern white pine, and white spruce.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 7L

Windbreak suitability group: 3

240B—Warba very fine sandy loam, 3 to 8 percent slopes

Composition

Warba soil and similar soils: 85 to 98 percent

Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Side slopes, shoulder slopes, and summits on moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 200 acres

Typical Profile

2 inches to 0—black, moderately decomposed forest litter

0 to 1 inch—very dark gray very fine sandy loam

1 to 6 inches—grayish brown very fine sandy loam

6 to 11 inches—light brownish gray very fine sandy loam

11 to 15 inches—light brownish gray very fine sandy loam and dark brown clay loam

- 15 to 18 inches—dark brown clay loam and light brownish gray loamy very fine sand
- 18 to 37 inches—light olive brown clay loam
- 37 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the Warba soil
- The somewhat poorly drained Stuntz soils on toe slopes or in swales
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Warba soil

Similar soils:

- Soils that have a surface layer of silt loam, sandy loam, or fine sandy loam
- Soils that have slightly more clay in the subsoil
- Soils that are moderately well drained
- Soils that have a sandy subsurface layer
- Soils in areas that have slopes of 0 to 3 percent or 8 to 15 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, American basswood, sugar maple, bigtooth aspen, northern red oak, and red pine. Species of limited extent are paper birch, balsam fir, eastern white pine, and white spruce.
- Ruts form easily if skidders are used when the soil is

wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.

- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 6L

Windbreak suitability group: 3

240C—Warba very fine sandy loam, 8 to 15 percent slopes

Composition

Warba soil and similar soils: 85 to 98 percent

Contrasting inclusions: 2 to 15 percent

Setting

Landform and position on the landform: Complex side slopes and shoulder slopes on moraines

Shape of areas: Long and narrow with lobate edges

Size of areas: 15 to 200 acres

Typical Profile

- 1 inch to 0—black, decomposed forest litter
- 0 to 2 inches—grayish brown very fine sandy loam
- 2 to 6 inches—light olive brown fine sandy loam
- 6 to 10 inches—light brownish gray fine sandy loam
- 10 to 16 inches—dark yellowish brown clay loam and light brownish gray fine sandy loam
- 16 to 36 inches—dark yellowish brown clay loam
- 36 to 60 inches—light olive brown clay loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Rapid

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the Warba soil
- The somewhat poorly drained Stuntz soils on toe slopes and in swales

Similar soils:

- Soils in areas that have slopes of 3 to 8 percent
- A few areas of soils that are sandy in the underlying material
- Some small areas of soils that have slightly more clay in the subsoil
- Soils that have a sandy subsurface layer
- Soils that have a surface layer of fine sandy loam or sandy loam

Use and Management**Cropland, pasture, and forage**

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, farming across the slope, and installing terraces, diversions, and grassed waterways reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, American basswood, sugar maple, bigtooth aspen, northern red oak, and red pine. Species of limited extent are paper birch, balsam fir, eastern white pine, and white spruce.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.
- The use of equipment is briefly restricted in spring and during other excessively wet periods. When the soil is wet, unsurfaced roads are slippery and ruts form easily.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 6L

Windbreak suitability group: 3

243—Stuntz very fine sandy loam**Composition**

Stuntz soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 50 acres

Typical Profile

- 1 inch to 0—black, slightly decomposed forest litter
- 0 to 1 inch—very dark gray silt loam
- 1 to 5 inches—grayish brown and light grayish brown very fine sandy loam
- 5 to 10 inches—light brownish gray, mottled very fine sandy loam
- 10 to 17 inches—grayish brown, mottled very fine sandy loam and olive brown and grayish brown, mottled sandy clay loam
- 17 to 22 inches—olive brown, mottled sandy clay loam and grayish brown, mottled very fine sandy loam
- 22 to 27 inches—olive brown, mottled sandy clay loam
- 27 to 34 inches—light olive brown, mottled clay loam
- 34 to 39 inches—light olive brown, mottled loam
- 39 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 1.5 to 3.0 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- Very poorly drained mineral soils in swales and depressions

Similar soils:

- Soils that have layers of silt loam or silty clay loam in the subsoil and underlying material
- A few areas of soils in which the water table is closer to the surface
- Soils that have a surface layer of fine sandy loam, loam, or silt loam

Use and Management**Cropland, pasture, and forage**

Major management factors: Seasonal high water table, wind erosion

- The major crops are oats and corn for silage.
- Wetness limits the choice of plants, restricts the period of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen, American basswood, sugar maple, and northern red oak. Species of limited extent are paper birch, balsam fir, American elm, and white spruce.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods.

Interpretive Groups

Land capability classification: 2w

Woodland ordination symbol: 7W

Windbreak suitability group: 1

268B—Cromwell sandy loam, 1 to 8 percent slopes

Composition

Cromwell soil and similar soils: 92 to 98 percent

Contrasting inclusions: 2 to 8 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains and moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 200 acres

Typical Profile

0 to 4 inches—very dark gray sandy loam

4 to 17 inches—dark brown sandy loam

17 to 25 inches—dark brown loamy sand
 25 to 35 inches—yellowish brown coarse sand
 35 to 47 inches—light yellowish brown sand
 47 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderate; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville soils, which have a sandy cap over sandy loam till; on convex swells
- The somewhat poorly drained Meehan soils, which are sandy throughout; in the lower landscape positions
- The moderately well drained, moderately wet Cromwell soils in the slightly lower landscape positions
- The excessively drained Menahga soils, which are sandy throughout; in the more sloping areas

Similar soils:

- Soils that have a thinner or thicker loamy mantle
- A few areas of soils that have a gravelly subsoil
- A few areas of soils in which the underlying material is loamy below a depth of 40 inches
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a surface layer of loam, fine sandy loam, silt loam, or loamy sand

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are paper birch, jack pine, balsam fir, eastern white pine, and sugar maple.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- If openings are made in the canopy, invading plants

can prevent the natural or artificial regeneration of desirable species.

- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 8S

Windbreak suitability group: 7

268C—Cromwell sandy loam, 8 to 15 percent slopes

Composition

Cromwell soil and similar soils: 92 to 98 percent

Contrasting inclusions: 2 to 8 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on outwash plains and moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 15 to 200 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam

3 to 5 inches—dark brown sandy loam

5 to 15 inches—yellowish brown sandy loam

15 to 30 inches—yellowish brown sand

30 to 60 inches—brown sand

Soil Properties and Qualities

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderate; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville soils, which have a sandy cap over sandy loam till; on knobs
- Very poorly drained organic soils in depressions
- The moderately well drained, moderately wet Cromwell soils in the nearly level, lower landscape positions
- The excessively drained Menahga soils, which are sandy throughout; in the more sloping areas

Similar soils:

- Soils that have a thicker or thinner loamy mantle
- Soils in which the underlying material is gravelly
- Soils in areas that have slopes of 1 to 8 percent
- Soils that have a surface layer of fine sandy loam,

loam, silt loam, or loamy sand

- A few areas of soils in which the underlying material is loamy below a depth of 40 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are paper birch, jack pine, balsam fir, eastern white pine, and sugar maple.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- If openings are made in the canopy, invading plants can prevent the natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 4e

Woodland ordination symbol: 8S

Windbreak suitability group: 7

292—Alstad fine sandy loam

Composition

Alstad soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes and toe slopes on moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 120 acres

Typical Profile

0 to 5 inches—very dark gray fine sandy loam
 5 to 15 inches—brown, mottled fine sandy loam
 15 to 20 inches—dark brown and brown, mottled sandy loam
 20 to 31 inches—strong brown, mottled sandy loam
 31 to 60 inches—brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Upper part—moderate; lower part—moderately slow
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- The well drained Cushing soils on convex rises
- The well drained Demontreville soils, which have a sandy mantle; in the higher landscape positions

Similar soils:

- Soils that have a water table at a depth of less than 1 foot
- Soils that have a surface layer of very fine sandy loam or loam

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, wind erosion

- The major crops are oats, corn for silage, and forage.
- Wetness limits the choice of plants, restricts the period of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of erosion.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotating grazing, mowing and clipping, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are American basswood, quaking aspen, northern red oak, and bigtooth aspen. Species of limited extent are balsam fir and paper birch.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods.

Interpretive Groups

Land capability classification: 2w
Woodland ordination symbol: 7W
Windbreak suitability group: 1

453B—Demontreville loamy sand, 2 to 8 percent slopes

Composition

Demontreville soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Complex side slopes and summits on moraines
Shape of areas: Long and wide with curvilinear edges
Size of areas: 5 to 150 acres

Typical Profile

0 to 4 inches—brown loamy sand
 4 to 10 inches—dark yellowish brown loamy sand
 10 to 25 inches—yellowish brown loamy sand
 25 to 33 inches—strong brown sandy loam and yellowish brown loamy sand
 33 to 47 inches—strong brown sandy loam
 47 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—rapid; lower part—moderately slow
Available water capacity: Low
Organic matter content: Low
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils in small depressions
- The well drained Cushing soils, which are loamy throughout; in landscape positions similar to those of the Demontreville soil

- The excessively drained Mahtomedi soils, which are sand and gravel throughout; in landscape positions similar to those of the Demontreville soil
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Demontreville soil

Similar soils:

- Soils that have a thicker or thinner sandy cap
- A few areas of soils that have a higher content of coarse fragments in the sandy cap
- Moderately well drained soils in areas that have slopes of less than 2 percent
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a thin surface layer of sandy loam, fine sandy loam, or loam
- Soils that have a surface layer of sand, loamy fine sand, or fine sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, jack pine, quaking aspen, and northern red oak. Species of limited extent are eastern white pine, American basswood, and white spruce.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Using special planting stock or containerized seedlings can also reduce the seedling mortality rate.
- Planting when the soil is moist can reduce seedling losses.
- If wheeled and tracked equipment is used, this soil is well suited to year-round logging, except during spring breakup.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 8S

Windbreak suitability group: 5

453C—Demontreville loamy sand, 8 to 15 percent slopes

Composition

Demontreville soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 2 inches—black loamy sand

2 to 6 inches—very dark grayish brown loamy sand

6 to 10 inches—dark brown loamy sand

10 to 14 inches—dark brown sand

14 to 20 inches—dark yellowish brown sand that has thin bands of brown loamy sand

20 to 33 inches—yellowish brown sand

33 to 40 inches—strong brown sandy loam and yellowish brown sand

40 to 60 inches—strong brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils in small depressions
- The well drained Cushing soils, which are loamy throughout; in landscape positions similar to those of the Demontreville soil
- The excessively drained Mahtomedi soils, which are sand and gravel throughout; in landscape positions similar to those of the Demontreville soil
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Demontreville soil

Similar soils:

- Soils that have a thicker or thinner sandy mantle
- Soils that have a surface layer of sand, fine sand, or loamy fine sand
- Soils in areas that have slopes of 3 to 8 percent or 15 to 40 percent
- Soils that have a higher content of coarse fragments

- Soils that have a thin surface layer of sandy loam, fine sandy loam, or loam

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, jack pine, quaking aspen, and northern red oak. Species of limited extent are eastern white pine, American basswood, and white spruce.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Planting when the soil is moist can reduce seedling losses.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- If wheeled and tracked equipment is used, this soil is well suited to year-round logging, except during spring breakup.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4e

Woodland ordination symbol: 8S

Windbreak suitability group: 5

453E—Demontreville loamy sand, 15 to 40 percent slopes

Composition

Demontreville soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Long and narrow with curvilinear edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 2 inches—very dark gray loamy sand

2 to 11 inches—dark brown loamy sand

11 to 25 inches—brown loamy sand

25 to 36 inches—strong brown loamy sand

36 to 60 inches—strong brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils in small depressions
- The well drained Cushing soils, which are loamy throughout; in landscape positions similar to those of the Demontreville soil
- The excessively drained Mahtomedi soils, which are sandy throughout; in landscape positions similar to those of the Demontreville soil
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Demontreville soil

Similar soils:

- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a surface layer of sand, loamy fine sand, or fine sand
- Soils that have a thicker or thinner sandy mantle
- Soils that have a higher content of coarse fragments in the sandy mantle
- Soils that have a thin surface layer of sandy loam or fine sandy loam

Use and Management

Pasture and forage

Major management factors: Water erosion

- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality

- The principal tree species are red pine, jack pine, quaking aspen, and northern red oak. Species of limited

extent are eastern white pine, American basswood, and white spruce.

- Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Planting when the soil is moist can reduce seedling losses.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Because loose sand and steep slopes can interfere with the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
- Landings can be established in small nearly level areas, if any are available, or in the nearly level adjacent areas.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 7e

Woodland ordination symbol: 8R

Windbreak suitability group: 5

454B—Mahtomedi loamy sand, 1 to 8 percent slopes

Composition

Mahtomedi soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes, shoulder slopes, and summits on outwash plains and moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 5 to 40 acres

Typical Profile

3 inches to 0—very dark grayish brown, moderately decomposed forest litter

0 to 2 inches—very dark grayish brown loamy sand

2 to 6 inches—dark yellowish brown loamy sand

6 to 12 inches—dark yellowish brown loamy coarse sand

12 to 20 inches—dark yellowish brown coarse sand

20 to 22 inches—yellowish brown sand

22 to 60 inches—light yellowish brown coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Sanburn soils, which have a loamy mantle over sand or sand and gravel; on upland summits
- The well drained Demontreville soils, which have loamy till in the underlying material

Similar soils:

- Soils in which the content of coarse fragments is less than 10 percent or more than 35 percent
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a surface layer of sandy loam, loamy coarse sand, sand, or coarse sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, and jack pine. Species of limited extent are bigtooth aspen and eastern white pine.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 8S

Windbreak suitability group: 7

454C—Mahtomedi loamy sand, 8 to 15 percent slopes

Composition

Mahtomedi soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on outwash plains and moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 2 inches—black loamy sand
2 to 6 inches—dark brown gravelly loamy sand
6 to 11 inches—dark brown sand
11 to 18 inches—brown gravelly sand
18 to 22 inches—yellowish brown gravelly sand
22 to 36 inches—brown gravelly sand
36 to 48 inches—dark brown gravelly sand
48 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Sanburn soils, which formed in a loamy mantle over sand or sand and gravel; on upland summits
- The well drained Demontreville soils, which have loamy till in the lower part

Similar soils:

- Soils that have a surface layer of loamy coarse sand, sand, or coarse sand
- Soils that have subhorizons containing less than 10 percent or more than 35 percent coarse fragments
- Soils in areas that have slopes of 1 to 8 percent or 15 to 40 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.

- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, and jack pine. Species of limited extent are bigtooth aspen and eastern white pine.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 8S

Windbreak suitability group: 7

454E—Mahtomedi loamy sand, 15 to 40 percent slopes

Composition

Mahtomedi soil and similar soils: 90 to 95 percent
Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Ridges and convex side slopes on outwash plains and moraines

Shape of areas: Elongated

Size of areas: 15 to 100 acres

Typical Profile

0 to 1 inch—very dark gray loamy sand
1 to 9 inches—dark grayish brown loamy sand
9 to 14 inches—yellowish brown sand
14 to 39 inches—yellowish brown gravelly sand
39 to 60 inches—light yellowish brown gravelly sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Sanburn soils, which formed in a loamy mantle over sand or sand and gravel; on upland summits
- The well drained Demontreville soils, which have loamy till in the lower part; in landscape positions similar to those of the Mahtomedi soil

Similar soils:

- Soils in which the content of gravel is less than 10 percent or more than 35 percent
- Soils in areas that have slopes of less than 15 percent
- Soils that have cobbles on the surface

Use and Management

Pasture and forage

Major management factors: Available water capacity, water erosion

- Adjusting stocking rates, especially on the steeper slopes, discouraging selective grazing, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality

- The principal tree species are red pine, northern red oak, and jack pine. Species of limited extent are bigtooth aspen and eastern white pine.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because loose sand and steep slopes can interfere with the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
- Landings can be established in small nearly level areas, if any are available, or in the nearly level adjacent areas.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 7s

Woodland ordination symbol: 8R

Windbreak suitability group: 7

458A—Menahga loamy sand, 0 to 3 percent slopes

Composition

Menahga soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Broad, nearly level flats on outwash plains

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 70 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand

3 to 25 inches—dark yellowish brown coarse sand

25 to 60 inches—yellowish brown coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils on the lower lying slopes
- The well drained Demontreville soils, which have loamy till below a depth of 20 to 40 inches; on slight swells
- The somewhat poorly drained Meehan soils in the lower landscape positions
- The very poorly drained Roscommon soils in drainageways

Similar soils:

- Soils that have a surface layer of sand, coarse sand, loamy coarse sand, or sandy loam
- Soils that have a thicker and darker surface layer
- Soils in areas that have slopes of 3 to 8 percent
- Soils in which the content of coarse fragments is more than 10 percent
- Soils that have thin bands of loamy material in the subsoil
- Soils that have loamy underlying layers

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field

windbreaks, and using minimum tillage reduce the hazard of wind erosion.

- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, bigtooth aspen, and jack pine. Species of limited extent are balsam fir, paper birch, quaking aspen, and eastern white pine.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

458B—Menahga loamy sand, 3 to 8 percent slopes

Composition

Menahga soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Knolls and side slopes on outwash plains

Shape of areas: Long and wide with smooth edges

Size of areas: 10 to 500 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand

3 to 12 inches—dark yellowish brown sand

12 to 20 inches—yellowish brown sand

20 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Meehan soils in the lower positions on the landscape
- The very poorly drained Roscommon soils in drainageways and depressions

Similar soils:

- Soils that have a thicker and darker surface layer
- Soils that have 10 to 35 percent gravel
- Soils that have thin bands of loamy material in the subsoil
- Soils that have a surface layer of loamy coarse sand, sand, coarse sand, or sandy loam
- Soils in areas that have slopes of 0 to 3 percent or 8 to 15 percent
- Soils that are underlain by loamy material

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that can tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Because of the limited available water capacity, most crops require irrigation.
- Maintaining crop residue on the surface, planting field windbreaks, and using minimum tillage reduce the hazards of wind erosion and water erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, bigtooth aspen, and jack pine. Species of limited extent are balsam fir, paper birch, quaking aspen, and eastern white pine.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before

planting, also reduces the seedling mortality rate.

- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

458C—Menahga loamy sand, 8 to 15 percent slopes

Composition

Menahga soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Knolls and side slopes on outwash plains

Shape of areas: Long and narrow with curvilinear edges

Size of areas: 5 to 40 acres

Typical Profile

1 inch to 0—black, moderately decomposed forest litter

0 to 3 inches—dark yellowish brown loamy sand

3 to 27 inches—dark yellowish brown loamy sand

27 to 36 inches—yellowish brown sand

36 to 44 inches—brown sand

44 to 60 inches—pale brown coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Meehan soils in nearly level or depressional areas

Similar soils:

- Soils that have a thicker and darker surface layer
- Soils that have 10 to 35 percent gravel
- Soils that have thin bands of loamy material in the subsoil
- Soils that have a surface layer of loamy coarse sand, sand, coarse sand, or sandy loam
- Soils in areas that have slopes of 3 to 8 percent or 15 to 30 percent
- Soils that are underlain by loamy material

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazards of wind erosion and water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, bigtooth aspen, and jack pine. Species of limited extent are balsam fir, paper birch, quaking aspen, and eastern white pine.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

458E—Menahga loamy sand, 15 to 40 percent slopes

Composition

Menahga soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Ridges, side slopes, and shoulder slopes on outwash plains

Shape of areas: Elongated

Size of areas: 15 to 60 acres

Typical Profile

0 to 1 inch—dark brown loamy sand
 1 to 5 inches—dark yellowish brown loamy sand
 5 to 22 inches—yellowish brown sand
 22 to 38 inches—pale brown sand
 38 to 60 inches—brown sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Meehan soils on toe slopes
- The very poorly drained Roscommon soils in depressions and drainageways

Similar soils:

- Soils that have a surface layer of loamy coarse sand, sand, or coarse sand
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have 10 to 35 percent gravel

Use and Management

Pasture and forage

Major management factors: Water erosion

- Adjusting stocking rates, especially on the steeper slopes, discouraging selective grazing, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality

- The principal tree species are red pine, northern red oak, bigtooth aspen, and jack pine. Species of limited extent are balsam fir, paper birch, quaking aspen, and eastern white pine.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because loose sand and steep slopes can interfere

with the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.

- Because of the slope, the number of suitable landing sites is minimal.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 7s

Woodland ordination symbol: 6R

Windbreak suitability group: 7

540—Seelyeville muck

Composition

Seelyeville soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and broad flats on outwash plains, valley trains, and moraines

Slope range: 0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 300 acres

Typical Profile

0 to 20 inches—black muck
 20 to 42 inches—dark reddish brown muck
 42 to 60 inches—dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderately rapid to moderately slow

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow or ponded

Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Greenwood soils, which are more acid than the Seelyeville soil; in raised areas of large bogs
- Very poorly drained mineral soils that have less than 16 inches of organic material; on the edges of depressions and drainageways

Similar soils:

- Soils that have a surface layer of mucky peat or peat
- Soils that have thin underlying layers of mineral soil material
- Soils that have layers derived from woody fibers

- Soils that are subject to ponding for short periods

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

541—Rifle mucky peat

Composition

Rifle soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions and broad flats on moraines, outwash plains, and till-floored glacial lake plains

Slope range: 0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 800 acres

Typical Profile

0 to 11 inches—dark reddish brown mucky peat

11 to 26 inches—very dark grayish brown mucky peat

26 to 50 inches—dark reddish brown mucky peat

50 to 60 inches—dark brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderately rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow or ponded

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Greenwood soils, which are more acid than the Rifle soil; in raised areas of large bogs
- Very poorly drained mineral soils that have less than 16 inches of organic material; on the edges of depressions

Similar soils:

- Soils that have a surface layer of muck or peat

- Soils that are subject to ponding for short periods
- Soils that formed in predominantly woody fibers

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing until the forage is at an optimum height help to keep the pasture in good condition.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are black ash, balsam fir, and tamarack. Species of limited extent are black spruce and northern whitecedar.
- The use of equipment is restricted during wet periods because the surface is soft and cannot support heavy loads.
- Planting water-tolerant species reduces the seedling mortality rate.
- Harvest methods that do not leave the remaining trees isolated or widely spaced reduce the windthrow hazard.
- Seedlings grow well if competing vegetation is controlled by herbicides or by mechanical removal.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: 3W

Windbreak suitability group: 10

543—Markey muck

Composition

Markey soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and drainageways on till-floored glacial lake plains, outwash plains, and moraines

Slope range: 0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 15 to 200 acres

Typical Profile

0 to 30 inches—black muck

30 to 60 inches—gray sand

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Roscommon soils, which are sandy throughout; on the edges of depressions and drainageways
- The somewhat poorly drained Meehan soils, which are sandy throughout; in the higher landscape positions

Similar soils:

- Some areas have more than 51 inches of organic material
- Soils that have a surface layer of mucky peat
- Soils that have finer textures in the underlying material

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

544—Cathro muck

Composition

Cathro soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and drainageways on moraines and till-floored glacial lake plains

Slope range: 0 to 2 percent

Shape of areas: Long and wide with curvilinear edges or circular

Size of areas: 15 to 300 acres

Typical Profile

0 to 15 inches—very dark brown muck

15 to 40 inches—black muck

40 to 60 inches—light brownish gray loam

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Upper part—moderately slow to moderately rapid; lower part—moderate or moderately slow

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow or ponded

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Runeberg soils, which are loamy throughout; on the edges of depressions and drainageways
- The poorly drained Staples soils, which formed in a sandy mantle and in the underlying dense, loamy till; on adjacent toe slopes
- The poorly drained Nokay soils, which are loamy throughout; on toe slopes adjacent to depressions and drainageways

Similar soils:

- Soils that have a surface layer of mucky peat
- Soils that have more than 51 inches or less than 16 inches of organic material above the loamy underlying material
- Soils that are sandy in the underlying material

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

549—Greenwood peat

Composition

Greenwood soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions, broad flats on moraines, outwash plains, and till-floored glacial lake plains

Slope range: 0 to 1 percent

Shape of areas: Long and wide with smooth edges or circular

Size of areas: 20 to 2,500 acres

Typical Profile

0 to 8 inches—light gray peat

8 to 38 inches—dark brown mucky peat

38 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow

Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Cathro soils, which are loamy in the underlying material; on the edges of depressions and adjacent mineral uplands
- The very poorly drained Nokasippi soils, which have a sandy mantle and have dense, loamy till in the underlying material; on the edges of depressions
- The very poorly drained Roscommon soils, which are sandy throughout; on the edges of depressions

Similar soils:

- Soils that have a surface layer of muck
- Soils that are less acid than the Greenwood soil and formed in predominantly woody fibers
- Soils that are more decomposed throughout

Use and Management

Cropland and pasture

- This soil is unsuited to most agricultural uses because of severe wetness.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are black spruce and tamarack.
- Ordinary crawler tractors or rubber-tired skidders generally cannot be used in areas of this soil. Special harvesting equipment is needed. Equipment can be used during periods in winter when access roads are frozen.
- The availability of landing sites is severely limited because of wetness.
- Because of wetness, seedling mortality and plant competition are severe.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.

- Windthrow can be minimized by using special harvest methods, such as selective cutting or strip cutting.

Interpretive Groups

Land capability classification: 7w

Woodland ordination symbol: 4W

Windbreak suitability group: 10

564—Friendship loamy sand

Composition

Friendship soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes and broad flats on outwash plains and moraines

Slope range: 0 to 3 percent

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 125 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand

4 to 28 inches—yellowish brown sand

28 to 37 inches—yellowish brown, mottled sand

37 to 43 inches—strong brown, mottled sand

43 to 60 inches—pale brown, mottled sand

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils, which have dense, loamy till in the underlying material
- The excessively drained Menahga soils in the higher landscape positions
- The very poorly drained Roscommon soils in depressions and drainageways

Similar soils:

- Soils in which the water table is closer to the surface
- Soils that have a surface layer of sand, loamy coarse sand, or sandy loam
- Soils that have loamy material below a depth of 40 inches
- Soils that have 10 to 35 percent gravel in the subsoil

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are jack pine, red pine, and quaking aspen.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 7S

Windbreak suitability group: 7

620B—Cutaway loamy sand, 1 to 10 percent slopes

Composition

Cutaway soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

- 0 to 1 inch—very dark gray loamy sand
- 1 to 2 inches—dark gray loamy sand
- 2 to 9 inches—brown sand
- 9 to 22 inches—light yellowish brown sand
- 22 to 27 inches—pale brown sand
- 27 to 31 inches—yellowish brown loamy sand and loam
- 31 to 37 inches—brown loam
- 37 to 42 inches—brown, calcareous loam
- 42 to 48 inches—light olive brown, calcareous sandy loam
- 48 to 60 inches—light yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow or slow

Available water capacity: Moderate

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the Cutaway soil
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Cutaway soil
- The somewhat poorly drained Sandwich soils on toe slopes and in drainageways

Similar soils:

- Soils that have a surface layer of sand, loamy fine sand, or fine sand
- Soils that have a thinner or thicker sandy mantle
- Soils that are moderately well drained
- Soils in areas that have slopes of 10 to 25 percent
- Soils that have sandy sediments below a depth of 5 feet

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are red pine, northern red oak, quaking aspen, balsam fir, and jack pine. Species of limited extent are paper birch, northern whitecedar, white spruce, and eastern white pine.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Using special planting stock or containerized seedlings can also reduce the seedling mortality rate.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 6S

Windbreak suitability group: 5

620D—Cutaway loamy sand, 10 to 25 percent slopes

Composition

Cutaway soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 10 to 50 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 7 inches—dark grayish brown loamy sand

7 to 31 inches—yellowish brown loamy sand

31 to 36 inches—brown loam and grayish brown loamy sand

36 to 43 inches—brown loam

43 to 60 inches—yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow or slow

Available water capacity: Moderate

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the Cutaway soil
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Cutaway soil
- The somewhat poorly drained Sandwick soils on toe slopes and in drainageways

Similar soils:

- Soils that have a surface layer of sand, loamy fine sand, or fine sand
- Soils that have a thinner or thicker sandy mantle
- Soils that have sandy sediments below a depth of 5 feet
- Soils in areas that have slopes of less than 10 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats and forage.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Runoff and erosion can be controlled by regulating the application of irrigation water.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality

- The principal tree species are red pine, northern red oak, quaking aspen, balsam fir, and jack pine. Species of limited extent are paper birch, northern whitecedar, white spruce, and eastern white pine.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Using special planting stock or containerized seedlings can also reduce the seedling mortality rate.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because loose sand and steep slopes can interfere with the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
- Landings can be established in small nearly level areas, if any are available, or in the nearly level adjacent areas.

- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 4e

Woodland ordination symbol: 6R

Windbreak suitability group: 5

625—Sandwich loamy sand

Composition

Sandwich soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes, toe slopes, and drainageways on moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 10 to 40 acres

Typical Profile

0 to 5 inches—black loamy sand

5 to 16 inches—dark grayish brown, mottled loamy sand

16 to 28 inches—yellowish brown, mottled loamy sand

28 to 35 inches—yellowish brown and grayish brown, mottled fine sandy loam

35 to 43 inches—grayish brown, mottled clay loam

43 to 50 inches—grayish brown, mottled, calcareous clay loam

50 to 60 inches—dark grayish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—moderately slow

Available water capacity: Low

Organic matter content: Moderately low or low

Surface runoff: Slow

Depth to the water table: 1 to 2 feet

Inclusions

Contrasting inclusions:

- The well drained Cutaway soils in the higher landscape positions
- The well drained Warba soils, which are loamy throughout; in the higher landscape positions
- The somewhat poorly drained Stuntz soils, which are loamy throughout; in landscape positions similar to those of the Sandwich soil

Similar soils:

- Soils that have a surface layer of loamy fine sand, fine sand, or sand
- Soils that have a thicker or thinner sandy mantle

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- The major crop is oats.
- Wetness limits the choice of plants and the period of grazing.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazard of wind erosion and conserve moisture.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen, paper birch, and balsam fir. Species of limited extent are eastern white pine and black ash.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods.
- If openings are made in the canopy, invading plants can prevent the natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 3w

Woodland ordination symbol: 7W

Windbreak suitability group: 2

665B—Menahga loamy sand, moraine, 3 to 8 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

0 to 1 inch—very dark gray loamy sand

1 to 3 inches—grayish brown loamy sand

3 to 22 inches—yellowish brown loamy sand

22 to 30 inches—yellowish brown coarse sand

30 to 60 inches—brown coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville and Cutaway soils, which have a sandy mantle 20 to 40 inches thick over loamy till; in landscape positions similar to those of the Menahga soil
- The well drained Cushing and Warba soils, which are loamy throughout; in landscape positions similar to those of the Menahga soil

Similar soils:

- Soils that contain 10 to 35 percent gravel
- Soils that have a surface layer of sand
- Soils that have more fine sand in the subsurface layer
- Soils in areas that have slopes of less than 3 percent or more than 8 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crop is oats.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion and conserve moisture.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, and jack pine. Species of limited extent are

eastern white pine and balsam fir.

- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 9S

Windbreak suitability group: 7

665C—Menahga loamy sand, moraine, 8 to 15 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 20 to 100 acres

Typical Profile

1 inch to 0—black, moderately decomposed forest litter

0 to 5 inches—very dark grayish brown loamy sand

5 to 9 inches—brown loamy sand

9 to 25 inches—strong brown sand

25 to 60 inches—strong brown sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville and Cutaway soils,

which have a sandy mantle 20 to 40 inches thick over loamy till; in landscape positions similar to those of the Menahga soil

- The well drained Cushing and Warba soils, which are loamy throughout; on summits

Similar soils:

- Soils that contain 10 to 35 percent gravel
- Soils that have a surface layer of sand
- Soils that have more fine sand in the subsurface layer
- Soils in areas that have slopes of 3 to 8 percent or 15 to 40 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crop is oats.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion and conserve moisture.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, and jack pine. Species of limited extent are eastern white pine and balsam fir.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 9S

Windbreak suitability group: 7

665E—Menahga loamy sand, moraine, 15 to 40 percent slopes

Composition

Menahga soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Side slopes, shoulder slopes, and ridges on moraines

Shape of areas: Long and narrow with curvilinear edges

Size of areas: 20 to 80 acres

Typical Profile

0 to 3 inches—very dark grayish brown loamy sand

3 to 5 inches—dark yellowish brown loamy sand

5 to 20 inches—yellowish brown sand

20 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Demontreville soils, which have a sandy mantle that is 20 to 40 inches thick; in landscape positions similar to those of the Menahga soil

Similar soils:

- Soils that contain 10 to 35 percent gravel
- Soils that have a surface layer of sand
- Soils that have more fine sand in the subsurface layer
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, water erosion

- Adjusting stocking rates, especially on the steeper slopes, discouraging selective grazing, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality, windthrow

- The principal tree species are red pine, quaking aspen, and jack pine. Species of limited extent are eastern white pine and balsam fir.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.

- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because loose sand and steep slopes can interfere with the traction of wheeled equipment, skid roads should be built on the contour or on the gentler slopes.
- Because of the slope, the number of suitable landing sites is minimal.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 7s

Woodland ordination symbol: 9R

Windbreak suitability group: 7

679B—Menahga loamy sand, loamy substratum, 2 to 8 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines and outwash plains

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 40 to 100 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 9 inches—dark grayish brown loamy sand

9 to 23 inches—yellowish brown sand

23 to 31 inches—dark yellowish brown sand

31 to 54 inches—yellowish brown sand

54 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderate

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils that have

a loamy substratum or that are sandy throughout; in the lower landscape positions

- The well drained Demontreville and Cutaway soils, which have a sandy mantle and are underlain by loamy material; in landscape positions similar to those of the Menahga soil

- The well drained Warba and Cushing soils, which are loamy throughout; in landscape positions similar to those of the Menahga soil

Similar soils:

- Soils that contain 10 to 35 percent gravel in the sandy material
- Soils that have loamy material above a depth of 40 inches
- Soils that have a surface layer of sand, loamy coarse sand, or coarse sand
- Soils in areas that have slopes of 8 to 15 percent
- Soils that are sandy throughout

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazards of wind erosion and water erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are jack pine, red pine, and quaking aspen. Species of limited extent are northern red oak and bur oak.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose

when dry, the use of wheeled and tracked equipment may be restricted.

- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

679C—Menahga loamy sand, loamy substratum, 8 to 15 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines and outwash plains

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 20 to 80 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 27 inches—dark grayish brown loamy sand

27 to 35 inches—yellowish brown sand

35 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderate

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils that have a loamy substratum; in the lower landscape positions
- The moderately well drained Friendship soils that are sandy throughout; in the slightly lower landscape positions
- The well drained Demontreville and Cutaway soils, which have a sandy mantle and are underlain by loamy material; in landscape positions similar to those of the Menahga soil
- The well drained Warba and Cushing soils, which are loamy throughout; in landscape positions similar to those of the Menahga soil

Similar soils:

- Soils that contain 10 to 35 percent gravel in the sandy material
- Soils that have loamy material above a depth of 40 inches
- Soils that have a surface layer of sand, loamy coarse sand, or coarse sand
- Soils in areas that have slopes of 2 to 8 percent
- Soils that are sandy throughout

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazards of wind erosion and water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are jack pine, red pine, and quaking aspen. Species of limited extent are northern red oak and bur oak.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

684—Bergkeller sandy loam, moderately wet**Composition**

Bergkeller soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Nearly level or slightly convex foot slopes on moraines

Slope range: 0 to 1 percent

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 10 to 25 acres

Typical Profile

0 to 5 inches—very dark grayish brown sandy loam

5 to 12 inches—yellowish brown sandy loam

12 to 20 inches—dark yellowish brown, mottled sandy loam

20 to 33 inches—dark brown, mottled sandy loam

33 to 43 inches—grayish brown coarse sand

43 to 60 inches—grayish brown gravelly coarse sand

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 2.5 to 6.0 feet

Inclusions

Contrasting inclusions:

- The very poorly drained Roscommon soils in depressions and drainageways
- The moderately well drained Friendship soils in landscape positions similar to those of the Bergkeller soil
- The somewhat poorly drained Meehan soils in slight depressions

Similar soils:

- Soils that are well drained
- Soils that have a surface layer of sand, loamy sand, loamy coarse sand, or fine sandy loam
- Soils that have a higher clay content in the subsoil

Use and Management**Cropland, pasture, and forage**

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.

- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.

- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and red pine. Species of limited extent are bigtooth aspen, paper birch, and bur oak.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 2s

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

701—Runeberg mucky loam, depressional**Composition**

Runeberg soil and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane and slightly concave areas in drainageways and depressions on drumlins and moraines

Slope range: 0 to 2 percent

Shape of areas: Irregular

Size of areas: 5 to 45 acres

Typical Profile

0 to 3 inches—black mucky loam

3 to 13 inches—very dark gray, mottled loam

13 to 19 inches—dark grayish brown, mottled loam

19 to 26 inches—olive gray, mottled sandy loam

26 to 60 inches—pale olive, mottled, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderately slow or slow

Available water capacity: Moderate

Organic matter content: High or very high

Surface runoff: Very slow or ponded

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils in the higher landscape positions
- The very poorly drained Roscommon soils, which are sandy throughout; adjacent to drainageways
- Very poorly drained organic soils that have organic layers over loamy material
- The somewhat poorly drained Paddock soils in the slightly higher landscape positions
- The poorly drained Staples soils, which have a sandy mantle over dense, loamy till

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have a sandy subsurface layer

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- The major crops are oats and corn for silage.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Pastures can be improved by installing a drainage system and by seeding the more desirable plants that are adapted to the wet conditions.
- Controlling brush and deferring grazing until the forage is at the proper height help to keep the pasture in good condition.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and black ash. Species of limited extent are white oak and green ash.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- If the overstory is removed, competition from undesirable species may be severe.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- The soil is usually wet from fall to early summer and can be wet during other periods. Equipment can be used only during dry periods in the summer and during winter when the snow cover is adequate.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: 3W

Windbreak suitability group: 10

703—Paddock loam

Composition

Paddock soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Toe slopes and summits on drumlins

Slope range: 0 to 2 percent

Shape of areas: Long and moderately wide with curvilinear edges or ovoid

Size of areas: 10 to 120 acres

Typical Profile

0 to 5 inches—black loam

5 to 14 inches—dark grayish brown and grayish brown, mottled sandy loam

14 to 19 inches—dark yellowish brown and brown, mottled sandy loam

19 to 41 inches—dark yellowish brown and light olive brown, mottled sandy loam

41 to 50 inches—yellowish brown, mottled sandy loam

50 to 60 inches—yellowish brown, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Special characteristics: A root-restricting layer at a depth of 50 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils, which have a sandy mantle 20 to 40 inches thick over dense till; in the higher landscape positions
- The very poorly drained Runeberg soils in depressions and swales

Similar soils:

- Soils that have a surface layer of loam, fine sandy loam, or loamy sand
- Soils that have a sandy subsurface layer
- Soils that have cobbles and boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- The major crops are oats, barley, and corn for silage.
- Wetness limits the choice of plants, restricts the period

of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.

- The underlying dense till restricts the growth of deep-rooted plants.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen and northern red oak. Species of limited extent are white spruce, black ash, American elm, white oak, and green ash.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 2w

Woodland ordination symbol: 4W

Windbreak suitability group: 1

720B—Blowers sandy loam, 1 to 5 percent slopes

Composition

Blowers soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Slightly concave and plane areas on hilltops on drumlins

Shape of areas: Elongated

Size of areas: 5 to 100 acres

Typical Profile

0 to 9 inches—very dark grayish brown sandy loam

9 to 25 inches—brown, grayish brown, and dark yellowish brown sandy loam

25 to 32 inches—yellowish brown, mottled sandy clay loam

32 to 49 inches—olive brown, mottled sandy loam

49 to 60 inches—light olive brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderate or high

Surface runoff: Medium

Depth to the water table: 2 to 3 feet

Special characteristics: A root-restricting layer at a depth of 49 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils, which have a sandy mantle; in landscape positions similar to those of the Blowers soil
- The well drained Redeye soils, which have a sandy mantle; in the slightly higher landscape positions
- The somewhat poorly drained Paddock soils on foot slopes

Similar soils:

- Soils that have a surface layer of loamy sand or fine sandy loam
- Soils that have a sandy subsurface layer
- Soils that are somewhat poorly drained
- Soils that have a higher clay content in the subsurface layer

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, northern red oak, and American basswood. Species of limited extent are red pine, white oak, American elm, jack pine, and white spruce.
- If large openings are made in the canopy, invading

plants can delay natural or artificial regeneration of desirable species.

- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 6L

Windbreak suitability group: 4F

730A—Sanburn sandy loam, 1 to 3 percent slopes

Composition

Sanburn soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Summits and foot slopes on outwash plains

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 3 inches—very dark gray sandy loam

3 to 13 inches—pale brown sandy loam

13 to 16 inches—brown and dark brown sandy loam

16 to 22 inches—dark brown gravelly sandy loam

22 to 24 inches—brown gravelly loamy sand

24 to 32 inches—brown gravelly sand

32 to 60 inches—yellowish brown gravelly sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Moderately low or low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Flak soils, which formed in dense, sandy loam till; in landscape positions similar to those of the Sanburn soil

- The excessively drained Mahtomedi soils, which do not have a sandy loam cap; in landscape positions similar to those of the Sanburn soil
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil
- The somewhat poorly drained Meehan soils in the lower lying depressions
- The moderately well drained, moderately wet Cromwell soils in the lower landscape positions

Similar soils:

- Soils that have a thicker or thinner sandy loam cap above the gravelly layer
- Soils in areas that have slopes of 3 to 8 percent
- Soils that have a surface layer of loam, fine sandy loam, or loamy sand

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

730B—Sanburn sandy loam, 3 to 8 percent slopes

Composition

Sanburn soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Knolls and side slopes on outwash plains

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

1 inch to 0—black, moderately decomposed forest litter

0 to 1 inch—black sandy loam

1 to 5 inches—dark grayish brown sandy loam

5 to 16 inches—brown sandy loam

16 to 21 inches—dark brown gravelly sandy loam

21 to 37 inches—brown gravelly coarse sand

37 to 60 inches—yellowish brown gravelly coarse sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Moderately low or low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Flak soils, which formed in dense, sandy loam till; in landscape positions similar to those of the Sanburn soil
- The excessively drained Mahtomedi soils, which do not have a sandy loam cap; in landscape positions similar to those of the Sanburn soil
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil
- The moderately well drained, moderately wet Cromwell soils in the slightly lower landscape positions

Similar soils:

- Soils that have thinner or thicker sandy loam layers above the gravelly material
- Soils in areas that have slopes of 0 to 3 percent or 8 to 15 percent
- Soils that have a surface layer of loamy sand or fine sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.

- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

730C—Sanburn sandy loam, 8 to 15 percent slopes

Composition

Sanburn soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and side slopes on outwash plains

Shape of areas: Moderately long and narrow with curvilinear edges or circular

Size of areas: 5 to 50 acres

Typical Profile

1 inch to 0—black forest litter

0 to 7 inches—very dark grayish brown sandy loam

7 to 16 inches—brown sandy loam

16 to 21 inches—dark yellowish brown sandy loam

21 to 23 inches—strong brown loamy sand

23 to 40 inches—dark yellowish brown gravelly sand

40 to 60 inches—yellowish brown and brownish yellow coarse sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Moderately low or moderate

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Flak soils, which formed in dense, sandy loam till; in landscape positions similar to those of the Sanburn soil
- The excessively drained Mahtomedi soils, which do not have a sandy loam cap; in landscape positions similar to those of the Sanburn soil
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil

Similar soils:

- Soils that have a thinner or thicker sandy loam cap
- Soils in areas that have slopes of 3 to 8 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Erosion results from the concentration of runoff on logging roads, in the tracks of wheeled equipment, and on landings.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 4e

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

731A—Sanburn loamy sand, 0 to 3 percent slopes

Composition

Sanburn soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains

Slope range: 0 to 3 percent

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 80 acres

Typical Profile

0 to 2 inches—black loamy sand

2 to 6 inches—dark brown loamy sand

6 to 15 inches—dark yellowish brown loamy sand

15 to 21 inches—dark brown sandy loam

21 to 33 inches—yellowish brown loamy sand

33 to 40 inches—light yellowish brown sand

40 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil
- The moderately well drained Friendship soils, which are sandy throughout; on foot slopes
- The very poorly drained Roscommon soils, which are sandy throughout; in depressions and drainageways

Similar soils:

- Soils that have a surface layer and subsurface layer of sandy loam or fine sandy loam
- Soils that are moderately well drained
- Soils in areas that have slopes of 3 to 8 percent
- Soils that contain 15 to 35 percent gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to

the soil conserve moisture and reduce the hazard of wind erosion.

- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

731B—Sanburn loamy sand, 3 to 8 percent slopes

Composition

Sanburn soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains

Slope range: 3 to 8 percent

Shape of areas: Long and wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 8 inches—very dark grayish brown loamy sand

8 to 19 inches—brown loamy sand

19 to 30 inches—dark brown sandy loam

30 to 36 inches—brown sand

36 to 60 inches—yellowish brown sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil
- The moderately well drained Friendship soils, which are sandy throughout; on foot slopes
- The very poorly drained Roscommon soils, which are sandy throughout; in depressions and drainageways

Similar soils:

- Soils that have a surface layer and subsurface layer of sandy loam or fine sandy loam
- Soils that are moderately well drained
- Soils in areas that have slopes of 1 to 3 percent or 8 to 15 percent
- Soils that contain 15 to 35 percent gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

731C—Sanburn loamy sand, 8 to 15 percent slopes

Composition

Sanburn soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on outwash plains

Slope range: 8 to 15 percent

Shape of areas: Moderately long and narrow with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

0 to 8 inches—very dark gray loamy sand

8 to 14 inches—brown loamy sand

14 to 18 inches—dark brown sandy loam

18 to 22 inches—dark brown gravelly sandy loam

22 to 36 inches—yellowish brown sand

36 to 60 inches—pale brown coarse sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the Sanburn soil
- The moderately well drained Friendship soils, which are sandy throughout; on foot slopes
- The very poorly drained Roscommon soils, which are sandy throughout; in depressions and drainageways

Similar soils:

- Soils that have a surface layer and subsurface layer of sandy loam or fine sandy loam
- Soils in areas that have slopes of 3 to 8 percent
- Soils that contain 15 to 35 percent gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing,

controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are jack pine and northern red oak. Species of limited extent are paper birch, bur oak, and bigtooth aspen.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Erosion results from the concentration of runoff on logging roads, in the tracks of wheeled equipment, and on landings.
- Because the soil is highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: 4e

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

732—Bushville loamy sand, 1 to 3 percent slopes

Composition

Bushville soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Level to convex side slopes and summits on drumlins and moraines

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 5 to 60 acres

Typical Profile

0 to 1 inch—black loamy sand

1 to 5 inches—brown loamy sand

5 to 27 inches—yellowish brown, mottled loamy sand

27 to 48 inches—dark brown, mottled sandy loam

48 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: 2 to 4 feet

Special characteristics: A root-restricting layer at a depth of 48 inches

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Watab soils on the lower lying slopes
- The very poorly drained Nokasippi soils in depressions
- The poorly drained Nokay soils, which do not have a sandy mantle; on the lower lying slopes

Similar soils:

- Soils that have a thicker or thinner sandy mantle

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine, jack pine, and northern red oak. Species of limited extent are eastern white pine and white spruce.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 4S

Windbreak suitability group: 5

739B—Wabedo sandy loam, 1 to 6 percent slopes, very stony

Composition

Wabedo soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and convex side slopes on drumlins

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 4 inches—very dark brown sandy loam

4 to 10 inches—dark brown sandy loam

10 to 19 inches—brown loamy sand

19 to 25 inches—dark brown sandy loam

25 to 41 inches—dark brown, mottled sandy loam

41 to 60 inches—strong brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Moderately low to high

Surface runoff: Slow

Depth to the water table: 1.5 to 2.5 feet

Special characteristics: A root-restricting layer at a depth of 41 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- The poorly drained Nokay soils in the lower landscape positions
- Very poorly drained organic soils in depressions

Similar soils:

- Soils that have a surface layer of fine sandy loam or gravelly sandy loam
- Soils that have sandy subhorizons
- Soils that have large cobbles and boulders on the surface

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, rock fragments

- The major crops grown are forage crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rock fragments on the surface severely hinder tillage and the planting of row crops.

- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are northern red oak, quaking aspen, bur oak, balsam fir, and American basswood. Species of limited extent are white spruce and eastern white pine.
- Because of the firm layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Rock fragments on the surface may hinder the use of equipment.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 4X

Windbreak suitability group: 4F

742B—Flak sandy loam, 3 to 8 percent slopes, very stony

Composition

Flak soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and convex side slopes on moraines and drumlins

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 5 to 50 acres

Typical Profile

0 to 4 inches—black sandy loam

4 to 13 inches—dark brown sandy loam

13 to 22 inches—brown sandy loam

22 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 22 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The poorly drained Nokay soils on flats and the upper parts of drainageways
- The moderately well drained Wabedo soils in the lower landscape positions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, rock fragments

- The major crops grown are forage crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rock fragments on the surface severely hinder tillage and the planting of row crops.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are northern red oak, quaking aspen, and American basswood. Species of limited extent are American elm, white oak, and jack pine.
- Because of the firm layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Rock fragments on the surface may hinder the use of equipment.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 3X

Windbreak suitability group: 4F

742C—Flak sandy loam, 8 to 15 percent slopes, very stony

Composition

Flak soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Shoulder slopes and convex side slopes on moraines and drumlins

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 80 acres

Typical Profile

0 to 4 inches—very dark brown sandy loam

4 to 15 inches—brown sandy loam

15 to 24 inches—dark brown sandy loam

24 to 30 inches—brown sandy loam

30 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 30 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The poorly drained Nokay soils on flats and the upper parts of drainageways
- The moderately well drained Wabedo soils in the lower landscape positions

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, rock fragments

- The major crops grown are forage crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rock fragments on the surface severely hinder tillage and the planting of row crops.
- Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are northern red oak, quaking aspen, and American basswood. Species of limited extent are American elm, white oak, and jack pine.
- Because of the firm layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- Rock fragments on the surface may hinder the use of equipment.

Interpretive Groups

Land capability classification: 7s

Woodland ordination symbol: 3X

Windbreak suitability group: 4F

750B—Pomroy loamy sand, 3 to 8 percent slopes, very stony

Composition

Pomroy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane or convex side slopes, shoulder slopes, and summits on drumlins

Shape of areas: Ovoid or moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 60 acres

Typical Profile

0 to 4 inches—very dark grayish brown loamy sand

4 to 14 inches—yellowish brown loamy fine sand

14 to 24 inches—brown fine sand

24 to 31 inches—brown, mottled sandy loam

31 to 42 inches—dark brown, mottled sandy loam

42 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 42 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Watab soils on the lower lying slopes
- The moderately well drained Wabedo soils, which do not have a sandy mantle; on the lower lying slopes
- The well drained Flak soils, which do not have a sandy mantle

Similar soils:

- Soils that have a thinner or thicker sandy mantle
- Soils in areas that have slopes of 0 to 3 percent or 8 to 15 percent
- Soils that have a surface layer of sandy loam, loamy fine sand, or fine sand

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, rock fragments

- The major crops grown are forage crops.
- Rock fragments on the surface severely hinder tillage and the planting of row crops.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.

- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine, jack pine, and northern red oak. Species of limited extent are eastern white pine and white spruce.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Rock fragments on the surface may hinder the use of equipment.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 4S

Windbreak suitability group: 5

750C—Pomroy loamy sand, 8 to 15 percent slopes, very stony

Composition

Pomroy soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on drumlins

Shape of areas: Elongated or circular

Size of areas: 5 to 50 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand

3 to 7 inches—brown sand

7 to 34 inches—yellowish brown sand

34 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low

Surface runoff: Medium

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 40 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Watab soils on the lower lying slopes
- Areas that have slopes of 1 to 3 percent or 8 to 15 percent
- The excessively drained Menahga soils on knobs

Similar soils:

- Soils in areas that have slopes of 3 to 8 percent
- Soils that have a thinner or thicker sandy mantle
- Soils that have a surface layer of loamy fine sand

Use and Management

Pasture and forage

Major management factors: Available water capacity, wind erosion, rock fragments

- The major crops grown are forage crops.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazard of wind erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.
- Rock fragments on the surface may hinder the use of equipment.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are red pine, jack pine, and northern red oak. Species of limited extent are eastern white pine and white spruce.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 4S

Windbreak suitability group: 5

773B—Warba-Cromwell complex, 1 to 8 percent slopes

Composition

Warba soil and similar soils: 40 to 50 percent

Cromwell soil and similar soils: 35 to 45 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 20 to 100 acres

Typical Profile

Warba

0 to 1 inch—black very fine sandy loam

1 to 3 inches—dark brown very fine sandy loam

3 to 17 inches—dark yellowish brown fine sandy loam

17 to 23 inches—grayish brown and brown loam

23 to 36 inches—brown loam

36 to 50 inches—dark yellowish brown loam

50 to 60 inches—olive brown loam

Cromwell

0 to 1 inch—black sandy loam

1 to 3 inches—dark grayish brown sandy loam

3 to 12 inches—dark yellowish brown fine sandy loam

12 to 16 inches—brown fine sandy loam

16 to 40 inches—dark yellowish brown loamy sand and sand

40 to 60 inches—dark yellowish brown sand

Soil Properties and Qualities

Drainage class: Warba—well drained; Cromwell—somewhat excessively drained

Permeability: Warba—moderately rapid in the upper part, moderately slow in the lower part; Cromwell—moderate in the upper part, rapid in the lower part

Available water capacity: Warba—high; Cromwell—low

Organic matter content: Warba—moderately low or moderate; Cromwell—low or moderately low

Surface runoff: Warba—medium; Cromwell—slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions and drainageways
- The somewhat poorly drained Stuntz soils, which are loamy throughout; on foot slopes and toe slopes
- The excessively drained Mahtomedi soils, which are sandy and gravelly throughout; on knobs
- The well drained Cutaway soils, which have a sandy mantle underlain by loamy material

Similar soils:

- Soils that have less clay in the subsoil
- Soils that have a silty mantle underlain by sand
- Soils that have sandy material underlain by loamy material below a depth of 40 inches
- Soils in areas that have slopes of 12 to 25 percent

Use and Management**Cropland, pasture, and forage**

Major management factors: Warba—wind erosion, water erosion; Cromwell—wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Planting field windbreaks and returning crop residue to the soil conserve moisture in areas of the Cromwell soil.
- In areas of the Warba soil, grazing during wet periods results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Warba—equipment limitations; Cromwell—seedling mortality

- The principal tree species are quaking aspen, paper birch, American basswood, northern red oak, and sugar maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, red pine, and balsam fir.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate on the Cromwell soil.

Interpretive Groups

Land capability classification: Warba—2e; Cromwell—3e

Woodland ordination symbol: Warba—6L; Cromwell—8S

Windbreak suitability group: Warba—3; Cromwell—7

773E—Warba-Cromwell complex, 8 to 25 percent slopes**Composition**

Warba soil and similar soils: 40 to 50 percent

Cromwell soil and similar soils: 35 to 45 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 40 to 100 acres

Typical Profile**Warba**

0 to 2 inches—very dark gray very fine sandy loam

2 to 11 inches—dark grayish brown very fine sandy loam

11 to 16 inches—dark grayish brown very fine sandy loam and brown clay loam

16 to 45 inches—brown clay loam

45 to 60 inches—yellowish brown loam

Cromwell

0 to 1 inch—very dark gray sandy loam

1 to 3 inches—dark gray sandy loam

3 to 5 inches—grayish brown fine sandy loam

5 to 12 inches—dark yellowish brown fine sandy loam

12 to 23 inches—yellowish brown fine sandy loam

23 to 35 inches—yellowish brown sand

35 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Warba—well drained; Cromwell—somewhat excessively drained

Permeability: Warba—moderately rapid in the upper part, moderately slow in the lower part; Cromwell—moderate in the upper part, rapid in the lower part

Available water capacity: Warba—high; Cromwell—moderate

Organic matter content: Warba—moderately low or moderate; Cromwell—low or moderately low

Surface runoff: Warba—rapid; Cromwell—medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions and drainageways
- The somewhat poorly drained Stuntz soils, which are loamy throughout; on foot slopes and toe slopes
- The excessively drained Mahtomedi soils, which are sandy and gravelly throughout; on knobs
- The well drained Cutaway soils, which have a sandy mantle underlain by loamy material

Similar soils:

- Soils that have less clay in the subsoil
- Soils that have a silty mantle underlain by sand
- Soils that have sandy material underlain by loamy

material below a depth of 40 inches

- Soils in areas that have slopes of 1 to 8 percent

Use and Management

Pasture and forage

Major management factors: Warba—wind erosion, water erosion; Cromwell—wind erosion, water erosion, available water capacity

- The major crops grown are forage crops.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Warba—equipment limitations, erosion; Cromwell—equipment limitations, erosion, seedling mortality

- The principal tree species are quaking aspen, paper birch, American basswood, northern red oak, and sugar maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, red pine, and balsam fir.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate on the Cromwell soil.
- Because the soils are highly erodible, the possible siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

Interpretive Groups

Land capability classification: Warba—4e; Cromwell—6e

Woodland ordination symbol: Warba—6R; Cromwell—8R

Windbreak suitability group: Warba—3; Cromwell—7

788—Cathro-Seelyeville complex

Composition

Cathro soil and similar soils: 40 to 50 percent

Seelyeville soil and similar soils: 35 to 45 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Depressions and drainageways on moraines and till-floored glacial lake plains

Slope range: 0 to 2 percent

Shape of areas: Circular or moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 40 acres

Typical Profile

Cathro

0 to 32 inches—black muck

32 to 34 inches—black silt loam

34 to 38 inches—greenish gray silty clay loam

38 to 60 inches—light greenish gray very fine sandy loam

Seelyeville

0 to 56 inches—black muck

56 to 60 inches—dark gray fine sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Cathro—moderately slow to moderately rapid in the upper part, moderate or moderately slow in the lower part; Seelyeville—moderately rapid to moderately slow

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow or ponded

Seasonal high water table: Cathro—1 foot above to 1 foot below the surface; Seelyeville—2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Greenwood soils, which are more acid than the major soils and formed in sphagnum moss
- Very poorly drained mineral soils on the edges of depressions and drainageways

Similar soils:

- Soils that have sandy underlying layers
- Soils that formed in predominantly woody fibers
- Soils in areas that are subject to ponding for short periods
- Soils that have a surface layer of peat or mucky peat

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: 10

797—Mooselake and Lupton soils

Composition

Mooselake soil and similar soils: 0 to 100 percent

Lupton soil and similar soils: 0 to 100 percent

Contrasting inclusions: 0 to 15 percent

Setting

Landform and position on the landform: Depressions and broad flats on till-floored glacial lake plains, outwash plains, and moraines

Slope range: 0 to 1 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 20 to 600 acres

Typical Profile

Mooselake

0 to 18 inches—black mucky peat

18 to 29 inches—dark brown mucky peat

29 to 35 inches—black muck

35 to 43 inches—dark reddish brown mucky peat

43 to 60 inches—black mucky peat

Lupton

0 to 25 inches—dark reddish brown muck

25 to 60 inches—dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Mooselake—moderately rapid; Lupton—moderately slow to moderately rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Very slow

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The very poorly drained Greenwood soils, which are more acid than the major soils; in raised areas of large bogs
- Very poorly drained mineral soils on the edges of depressions

Similar soils:

- Soils that have sandy or loamy underlying material above a depth of 51 inches
- Soils that formed in predominantly herbaceous fibers
- Soils in areas that are subject to ponding for short periods

Use and Management

Pasture and forage

Major management factors: Wetness

- Installing a drainage system and seeding plants that can tolerate wetness improve pastures.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are black spruce, whitecedar, and tamarack. Species of limited extent are black ash, paper birch, quaking aspen, red maple, balsam fir, and white spruce.
- Ordinary crawler tractors or rubber-tired skidders generally cannot be used on these soils. Special harvesting equipment is needed. Equipment can be used during periods in winter when access roads are frozen.
- The availability of landing sites is severely limited because of wetness.
- Because of wetness, seedling mortality and plant competition are severe.
- Because of the seasonal high water table, trees on these soils are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- Windthrow can be minimized by using special harvest methods, such as selective cutting or strip cutting.

Interpretive Groups

Land capability classification: Mooselake—6w; Lupton—7w

Woodland ordination symbol: 2W

Windbreak suitability group: 10

799—Bowstring-Seelyeville complex, frequently flooded

Composition

Bowstring soil and similar soils: 40 to 50 percent

Seelyeville soil and similar soils: 35 to 45 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Adjacent to streams in bogs on flood plains

Slope range: 0 to 1 percent

Shape of areas: Elongated

Size of areas: 15 to 200 acres

Typical Profile

Bowstring

0 to 6 inches—very dark brown muck
 6 to 32 inches—dark reddish brown muck
 32 to 40 inches—very dark gray and dark gray sand
 40 to 52 inches—dark reddish brown muck
 52 to 60 inches—very dark grayish brown muck

Seelyeville

0 to 10 inches—black muck
 10 to 42 inches—dark brown muck
 42 to 60 inches—black muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately rapid to moderately slow
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Very slow or ponded
Seasonal high water table: Bowstring—at the surface to 2 feet below the surface; Seelyeville—2 feet above to 2 feet below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:

- The very poorly drained Greenwood soils, which are more acid than the major soils and are not subject to flooding
- The very poorly drained Cathro soils, which have loamy underlying material above a depth of 51 inches and are not subject to flooding
- The very poorly drained Markey soils, which have sandy underlying material above a depth of 51 inches and are not subject to flooding

Similar soils:

- Mineral soils that are subject to flooding

Use and Management

- These soils are unsuited to most uses because of flooding and severe wetness, but they provide habitat for wetland wildlife (fig. 4).

Interpretive Groups

Land capability classification: 6w
Woodland ordination symbol: Not assigned
Windbreak suitability group: 10

870B—Itasca-Goodland complex, 1 to 8 percent slopes

Composition

Itasca soil and similar soils: 40 to 50 percent

Goodland soil and similar soils: 35 to 40 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 20 to 120 acres

Typical Profile

Itasca

0 to 3 inches—dark brown silt loam
 3 to 12 inches—brown silt loam
 12 to 20 inches—grayish brown silt loam
 20 to 25 inches—grayish brown silt loam and dark yellowish brown sandy loam
 25 to 43 inches—brown sandy loam
 43 to 60 inches—yellowish brown sandy loam

Goodland

0 to 1 inch—very dark grayish brown silt loam
 1 to 4 inches—grayish brown silt loam
 4 to 10 inches—dark yellowish brown silt loam
 10 to 13 inches—brown silt loam
 13 to 18 inches—brown very fine sandy loam and dark brown sandy loam
 18 to 27 inches—dark brown sandy loam
 27 to 35 inches—brown loamy coarse sand
 35 to 60 inches—dark brown coarse sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Itasca—moderate; Goodland—moderate in the upper part, rapid in the lower part
Available water capacity: Itasca—high; Goodland—moderate
Organic matter content: Moderately low or low
Surface runoff: Slow or medium
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions and drainageways
- Soils that have a mantle of sand; in landscape positions similar to those of the major soils
- The somewhat poorly drained Stuntz soils, which are loamy throughout; on foot slopes and toe slopes

Similar soils:

- Soils that have more clay in the subsoil
- Soils in areas that have slopes of 8 to 15 percent
- Soils that have a surface layer of very fine sandy loam
- Soils that are moderately well drained



Figure 4.—This area of Bowstring-Seelyeville complex, frequently flooded, provides good habitat for wetland wildlife.

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion.
- Grazing when these soils are wet results in compaction of the surface layer, poor tilth, and excessive runoff.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, paper birch, American basswood, northern red oak, and sugar maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, red pine, and balsam fir.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: Itasca—7A; Goodland—7L

Windbreak suitability group: Itasca—3; Goodland—6G

870C—Itasca-Goodland complex, 8 to 15 percent slopes

Composition

Itasca soil and similar soils: 40 to 50 percent
 Goodland soil and similar soils: 35 to 40 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 20 to 120 acres

Typical Profile

Itasca

0 to 6 inches—grayish brown silt loam
 6 to 16 inches—yellowish brown very fine sandy loam
 16 to 20 inches—grayish brown very fine sandy loam
 20 to 23 inches—light brownish gray very fine sandy loam and dark yellowish brown sandy loam
 23 to 29 inches—dark brown sandy loam and light brownish gray loamy very fine sand
 29 to 48 inches—dark yellowish brown sandy loam
 48 to 60 inches—light olive brown sandy loam

Goodland

0 to 1 inch—very dark gray silt loam
 1 to 6 inches—dark grayish brown silt loam
 6 to 14 inches—dark brown very fine sandy loam
 14 to 18 inches—brown very fine sandy loam
 18 to 26 inches—brown fine sandy loam and dark yellowish brown sandy loam
 26 to 40 inches—dark yellowish brown sandy loam
 40 to 46 inches—dark brown gravelly loamy sand
 46 to 60 inches—dark brown gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Itasca—moderate; Goodland—moderate in the upper part, rapid in the lower part
Available water capacity: Itasca—high; Goodland—moderate
Organic matter content: Moderately low or low
Surface runoff: Slow or medium
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions and drainageways
- Soils that have a mantle of sand; in landscape positions similar to those of the major soils
- The somewhat poorly drained Stuntz soils, which are loamy throughout; on foot slopes and toe slopes

Similar soils:

- Soils that have more clay in the subsoil
- Soils in areas that have slopes of 1 to 8 percent
- Soils that have a surface layer of very fine sandy loam
- Soils that are moderately well drained

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops grown are forage crops.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, paper birch, American basswood, northern red oak, and sugar maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, red pine, and balsam fir.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.
- Undesirable plants may invade in clear-cut areas and thus may prevent the establishment of desired species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.

Interpretive Groups

Land capability classification: 3e
Woodland ordination symbol: Itasca—7A; Goodland—7L
Windbreak suitability group: Itasca—3; Goodland—6G

928B—Demontreville-Mahtomedi-Cushing complex, 2 to 8 percent slopes

Composition

Demontreville soil and similar soils: 35 to 45 percent
 Mahtomedi soil and similar soils: 25 to 35 percent
 Cushing soil and similar soils: 20 to 30 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Demontreville—side slopes and summits on moraines;
 Mahtomedi—side slopes and shoulder slopes on moraines; Cushing—summits on moraines
Slope range: 2 to 8 percent
Shape of areas: Long and wide with curvilinear edges
Size of areas: 30 to 100 acres

Typical Profile

Demontreville

0 to 2 inches—very dark gray loamy sand

- 2 to 7 inches—brown loamy sand
- 7 to 22 inches—yellowish brown loamy sand
- 22 to 39 inches—brown loamy sand and dark brown sandy loam
- 39 to 60 inches—dark brown sandy loam

Mahtomedi

- 0 to 2 inches—very dark gray loamy sand
- 2 to 9 inches—brown loamy sand
- 9 to 16 inches—dark yellowish brown loamy sand
- 16 to 60 inches—dark yellowish brown gravelly sand

Cushing

- 0 to 3 inches—very dark grayish brown fine sandy loam
- 3 to 11 inches—brown sandy loam
- 11 to 19 inches—brown sandy loam and dark brown loam
- 19 to 32 inches—dark brown loam
- 32 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Demontreville—well drained; Mahtomedi—excessively drained; Cushing—well drained

Permeability: Demontreville—rapid in the upper part, moderately slow in the lower part; Mahtomedi—rapid; Cushing—moderate in the upper part, moderately slow in the lower part

Available water capacity: Demontreville—low; Mahtomedi—low; Cushing—moderate

Organic matter content: Demontreville—low; Mahtomedi—low; Cushing—moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils on toe slopes and foot slopes
- Very poorly drained organic soils in depressions
- The somewhat poorly drained Meehan soils on toe slopes and foot slopes

Similar soils:

- Soils in areas that have slopes of 8 to 15 percent

Use and Management**Cropland, pasture, and forage**

Major management factors: Demontreville—available water capacity, wind erosion; Mahtomedi—available water capacity, wind erosion; Cushing—wind erosion, water erosion

- The major crops are oats and corn for silage.
- Crops that tolerate drought are best suited in areas of

the Demontreville and Mahtomedi soils. The available moisture is not adequate for good growth of other crops.

- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- In areas of the Cushing soil, grazing during wet periods results in compaction of the surface layer, poor tilth, and excessive runoff.
- Installing terraces, diversions, and grassed waterways, using minimum tillage, and maintaining crop residue on or near the surface reduce the hazard of erosion on the Cushing soil.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Demontreville—seedling mortality; Mahtomedi—equipment limitations, seedling mortality; Cushing—equipment limitations

- The principal tree species are red pine, northern red oak, American basswood, quaking aspen, sugar maple, and red maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, yellow birch, and jack pine.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate on the Demontreville and Mahtomedi soils. Planting when the soils are moist can also reduce the seedling mortality rate.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration on the Cushing soil.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- The use of equipment is briefly restricted on the Cushing soil in spring and during other excessively wet periods. When this soil is wet, unsurfaced roads are slippery and ruts form easily. Using wheeled and tracked equipment when the soil is wet produces ruts and increases compaction.
- Because the upper part of the Demontreville and Mahtomedi soils becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: Demontreville—3s; Mahtomedi—4s; Cushing—2e

Woodland ordination symbol: Demontreville—8S; Mahtomedi—8S; Cushing—6L

Windbreak suitability group: Demontreville—5; Mahtomedi—7; Cushing—3

928C—Demontreville-Mahtomedi-Cushing complex, 8 to 15 percent slopes

Composition

Demontreville soil and similar soils: 35 to 45 percent

Mahtomedi soil and similar soils: 25 to 35 percent

Cushing soil and similar soils: 20 to 30 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on moraines

Shape of areas: Long and wide with curvilinear edges

Size of areas: 30 to 100 acres

Typical Profile

Demontreville

0 to 1 inch—black loamy sand

1 to 8 inches—brown loamy sand

8 to 12 inches—yellowish brown loamy sand

12 to 31 inches—pale brown and yellowish brown loamy sand

31 to 46 inches—brown sandy loam

46 to 60 inches—strong brown sandy loam

Mahtomedi

0 to 2 inches—very dark grayish brown loamy sand

2 to 4 inches—brown loamy sand

4 to 19 inches—yellowish brown loamy sand

19 to 31 inches—yellowish brown coarse sand

31 to 60 inches—yellowish brown gravelly coarse sand

Cushing

0 to 3 inches—very dark gray fine sandy loam

3 to 8 inches—brown sandy loam

8 to 15 inches—brown sandy loam and yellowish brown loam

15 to 21 inches—yellowish brown loam and brown sandy loam

21 to 40 inches—yellowish brown loam

40 to 60 inches—yellowish brown sandy loam

Soil Properties and Qualities

Drainage class: Demontreville—well drained; Mahtomedi—excessively drained; Cushing—well drained

Permeability: Demontreville—rapid in the upper part, moderately slow in the lower part; Mahtomedi—rapid; Cushing—moderate in the upper part, moderately slow in the lower part

Available water capacity: Demontreville—low; Mahtomedi—low; Cushing—moderate

Organic matter content: Demontreville—low; Mahtomedi—low; Cushing—moderately low

Surface runoff: Demontreville—medium; Mahtomedi—slow; Cushing—medium

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils on toe slopes and foot slopes
- Very poorly drained organic soils in depressions
- The somewhat poorly drained Meehan soils on toe slopes and foot slopes

Similar soils:

- Soils in areas that have slopes of 2 to 8 percent or 15 to 40 percent

Use and Management

Cropland, pasture, and forage

Major management factors: Demontreville—wind erosion, water erosion, available water capacity; Mahtomedi—available water capacity, wind erosion, water erosion; Cushing—wind erosion, water erosion

- The major crops are oats and corn for silage.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Crops that tolerate drought are best suited in areas of the Demontreville and Mahtomedi soils. The available moisture is not adequate for good growth of other crops.
- In areas of the Cushing soil, grazing during wet periods results in compaction of the surface layer, poor tilth, and excessive runoff.
- Chisel plowing, farming across the slope, and installing terraces, diversions, and grassed waterways reduce the hazard of water erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Demontreville—seedling mortality; Mahtomedi—equipment limitations, seedling mortality; Cushing—equipment limitations

- The principal tree species are red pine, northern red oak, American basswood, quaking aspen, sugar maple, and red maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, yellow birch, and jack pine.
- Special site preparation, such as scalping before planting, reduces the seedling mortality rate on the Demontreville and Mahtomedi soils. Planting when the soils are moist also reduces the seedling mortality rate.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration on the Cushing soil.

- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- The use of equipment is briefly restricted on the Cushing soil in spring and during other excessively wet periods. When this soil is wet, unsurfaced roads are slippery and ruts form easily. Using wheeled and tracked equipment when the soil is wet produces ruts and increases compaction.
- Because the upper part of the Demontreville and Mahtomedi soils becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: Demontreville—4e; Mahtomedi—6s; Cushing—3e
Woodland ordination symbol: Demontreville—8S; Mahtomedi—8S; Cushing—6L
Windbreak suitability group: Demontreville—5; Mahtomedi—7; Cushing—3

928E—Demontreville-Mahtomedi-Cushing complex, 15 to 40 percent slopes

Composition

Demontreville soil and similar soils: 35 to 45 percent
 Mahtomedi soil and similar soils: 25 to 35 percent
 Cushing soil and similar soils: 20 to 30 percent
 Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Demontreville and Mahtomedi—side slopes and shoulder slopes on moraines; Cushing—side slopes on moraines
Slope range: Demontreville—15 to 40 percent; Mahtomedi—15 to 40 percent; Cushing—15 to 30 percent
Shape of areas: Long and moderately wide with curvilinear edges
Size of areas: 30 to 300 acres

Typical Profile

Demontreville

0 to 4 inches—very dark brown loamy sand
 4 to 10 inches—brown loamy sand
 10 to 33 inches—dark yellowish brown sand
 33 to 42 inches—dark brown fine sandy loam
 42 to 60 inches—dark reddish brown sandy loam

Mahtomedi

0 to 3 inches—black loamy sand
 3 to 23 inches—dark brown sand
 23 to 60 inches—brown gravelly sand

Cushing

0 to 7 inches—dark brown fine sandy loam

7 to 16 inches—pale brown loam
 16 to 21 inches—pale brown and dark brown loam
 21 to 29 inches—dark brown and pale brown clay loam
 29 to 49 inches—dark brown clay loam
 49 to 60 inches—dark brown sandy clay loam

Soil Properties and Qualities

Drainage class: Demontreville—well drained; Mahtomedi—excessively drained; Cushing—well drained
Permeability: Demontreville—rapid in the upper part, moderately slow in the lower part; Mahtomedi—rapid; Cushing—moderate in the upper part, moderately slow in the lower part
Available water capacity: Demontreville—low; Mahtomedi—low; Cushing—moderate
Organic matter content: Demontreville—low; Mahtomedi—low; Cushing—moderately low
Surface runoff: Demontreville—medium; Mahtomedi—medium; Cushing—rapid
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Alstad soils on toe slopes and foot slopes
- Very poorly drained organic soils in depressions
- The somewhat poorly drained Meehan soils on toe slopes and foot slopes

Similar soils:

- Soils in areas that have slopes of 8 to 15 percent

Use and Management

Pasture and forage

Major management factors: Slope

- Returning crop residue to the soil, adjusting stocking rates, especially on the steeper slopes, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, erosion, seedling mortality

- The principal tree species are red pine, northern red oak, American basswood, quaking aspen, sugar maple, and red maple. Species of limited extent are eastern white pine, white spruce, bigtooth aspen, yellow birch, and jack pine.
- Plant competition can be expected to prevent natural or planted regeneration unless precautionary measures are taken on the Cushing soil. Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because the soils are highly erodible, the possible

siltation of nearby lakes and streams is a concern. Using only those logging methods that do not disturb the organic mat helps to prevent this pollution.

- Because of the slope, the number of suitable landing sites is minimal. Preferred locations for landings are on the nearly level parts of this unit.
- Special care is needed in laying out roads and landings and in operating the equipment. Roads can be designed so that they conform to the topography. The grade should be kept as low as possible.
- Because of droughtiness, seedling mortality is a concern. Using special planting stock or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: Demontreville—7e; Mahtomedi—7s; Cushing—6e

Woodland ordination symbol: Demontreville—8R; Mahtomedi—8R; Cushing—6R

Windbreak suitability group: Demontreville—5; Mahtomedi—7; Cushing—3

1002—Fluvaquents, frequently flooded

Composition

Fluvaquents and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Adjacent to streams on flood plains

Slope range: 0 to 2 percent

Shape of areas: Elongated

Size of areas: 15 to 200 acres

Typical Profile

0 to 5 inches—black silt loam

5 to 12 inches—dark grayish brown very fine sandy loam

12 to 30 inches—dark grayish brown, mottled very fine sandy loam

30 to 60 inches—dark grayish brown, mottled fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Moderate to rapid

Available water capacity: High to low

Organic matter content: Moderate or moderately low

Surface runoff: Very slow

Seasonal high water table: At the surface to 2 feet below the surface

Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Meehan soils, which are not subject to flooding; in the higher landscape positions
- The poorly drained Staples soils, which are not subject to flooding; in the higher landscape positions

Similar soils:

- Some areas are predominantly organic soils that are subject to flooding.

Use and Management

- These soils are unsuited to most uses because of flooding and severe wetness, but they provide habitat for wetland wildlife.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: Not assigned

Windbreak suitability group: Not assigned

1141—Runeberg loam, acid substratum, depressional

Composition

Runeberg soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Toe slopes, depressions, and drainageways on drumlins and moraines

Slope range: 0 to 2 percent

Shape of areas: Long and narrow with curvilinear edges

Size of areas: 5 to 80 acres

Typical Profile

0 to 10 inches—black loam

10 to 14 inches—very dark gray sandy loam

14 to 27 inches—olive gray, mottled sandy loam

27 to 60 inches—gray, mottled sandy loam

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderately slow or slow

Available water capacity: Moderate

Organic matter content: High or very high

Surface runoff: Very slow

Surface runoff: Very slow or ponded

Depth to the water table: 0.5 foot to 2.0 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils in the higher landscape positions
- The very poorly drained Roscommon soils, which are sandy throughout; adjacent to drainageways
- The very poorly drained Cathro soils, which have organic layers over loamy material
- The somewhat poorly drained Paddock soils in the slightly higher landscape positions
- The poorly drained Staples soils, which have a sandy mantle over dense, loamy till

Similar soils:

- Soils that have a surface layer of fine sandy loam
- Soils that have a sandy subsurface layer

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- The major crops are oats and corn for silage.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Pastures can be improved by installing a drainage system and by seeding the more desirable plants that are adapted to the wet conditions.
- Controlling brush and deferring grazing when the soil is wet and until the forage is at an optimum height help to keep the pasture in good condition.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and black ash. Species of limited extent are white oak and green ash.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- If the overstory is removed, competition from undesirable species may be severe.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Using wheeled and tracked equipment on wet soil produces ruts, compacts the soil, and damages the roots of trees.
- The soil is usually wet from fall to early summer and can be wet during other periods. Equipment can be used only during dry periods in the summer and during winter when the snow cover is adequate.

Interpretive Groups

Land capability classification: 6w, undrained

Woodland ordination symbol: 3W

Windbreak suitability group: 10

1151B—Blowers sandy loam, acid substratum, 1 to 5 percent slopes

Composition

Blowers soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes, side slopes, and summits on drumlins

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 5 inches—black sandy loam

5 to 10 inches—brown sandy loam

10 to 17 inches—brown and yellowish brown sandy loam

17 to 23 inches—yellowish brown and brown, mottled sandy loam

23 to 35 inches—dark yellowish brown, mottled sandy loam

35 to 60 inches—yellowish brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderate or high

Surface runoff: Medium

Depth to the water table: 2 to 3 feet

Special characteristics: A root-restricting layer at a depth of 44 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils, which have a sandy mantle; in landscape positions similar to those of the Blowers soil
- The well drained Redeye soils, which have a sandy mantle; in the slightly higher landscape positions
- The somewhat poorly drained Paddock soils on foot slopes

Similar soils:

- Soils that have a surface layer of loamy sand or fine sandy loam
- Soils that have a sandy subsurface layer
- Soils that are somewhat poorly drained
- Soils that have a higher clay content in the subsurface layer

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, northern red oak, and American basswood. Species of limited extent are red pine, white oak, American elm, jack pine, and white spruce.
- If large openings are made in the canopy, invading plants can delay natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- Ruts form easily if skidders are used when the soil is wet. Deep ruts can restrict lateral drainage, alter soil structure, and damage tree roots.

Interpretive Groups

Land capability classification: 2e

Woodland ordination symbol: 6L

Windbreak suitability group: 4F

1153B—Huntersville loamy sand, acid substratum, 1 to 6 percent slopes

Composition

Huntersville soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Convex or concave side slopes and summits on drumlins

Shape of areas: Ovoid, elongated, or moderately long and moderately wide with smooth edges

Size of areas: 5 to 200 acres

Typical Profile

0 to 7 inches—very dark grayish brown loamy sand

7 to 14 inches—grayish brown and yellowish brown loamy sand

14 to 26 inches—yellowish brown, mottled loamy sand

26 to 58 inches—yellowish brown, mottled sandy loam

58 to 60 inches—light brownish gray, mottled sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 2.5 to 4.0 feet

Special characteristics: A root-restricting layer at a depth of 58 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils, which are sandy throughout; in landscape positions similar to those of the Huntersville soil
- The poorly drained Staples soils on nearly level, concave slopes and in drainageways
- The very poorly drained Runeberg soils, which are sandy loam throughout; in drainageways
- The somewhat poorly drained Paddock soils on foot slopes
- Soils that have lenses and layers of sand and gravel; on toe slopes adjacent to drainageways

Similar soils:

- Soils that have a slightly thicker or thinner sandy mantle
- Soils that are well drained
- A few areas of soils that have steeper slopes
- Soils that have a surface layer of loamy fine sand, sand, or sandy loam

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur oak, bigtooth aspen, and northern red oak.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 6L

Windbreak suitability group: 5

1155—Staples loamy sand, acid substratum

Composition

Staples soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes and toe slopes on drumlins

Slope range: 0 to 2 percent

Shape of areas: Elongated

Size of areas: 5 to 200 acres

Typical Profile

- 0 to 4 inches—very dark brown loamy sand
- 4 to 9 inches—grayish brown, mottled loamy sand
- 9 to 18 inches—light brownish gray, mottled loamy sand
- 18 to 27 inches—brown, mottled sand
- 27 to 35 inches—brown, mottled sandy loam
- 35 to 41 inches—brown loamy sand
- 41 to 60 inches—yellowish brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 0.5 foot to 2.0 feet

Special characteristics: A root-restricting layer at a depth of 41 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils in the higher landscape positions

- The very poorly drained Cathro soils, which have organic layers over loamy material
- The very poorly drained Markey soils, which have organic layers over sandy material
- The somewhat poorly drained Paddock soils, which are loamy throughout; in the slightly higher landscape positions

Similar soils:

- Soils that have a thicker or thinner sandy mantle
- Soils that have a surface layer of sandy loam or sand
- Soils that have boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- The major crops are oats and corn for silage.
- Wetness limits the choice of plants and the period of grazing.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of wind erosion.
- The underlying dense till restricts the growth of deep-rooted plants.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and northern red oak. Species of limited extent are black ash, jack pine, white oak, and American elm.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Because of droughtiness, seasonal wetness, and restricted rooting depth, seedling mortality is a concern. Using special planting stock or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3w

Woodland ordination symbol: 6W

Windbreak suitability group: 2

1157—Paddock loam, acid substratum

Composition

Paddock soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Toe slopes and summits on drumlins

Slope range: 0 to 2 percent

Shape of areas: Long and moderately wide with curvilinear edges or ovoid

Size of areas: 10 to 120 acres

Typical Profile

0 to 7 inches—black loam

7 to 13 inches—dark grayish brown sandy loam

13 to 20 inches—dark brown, mottled sandy loam

20 to 31 inches—yellowish brown, mottled sandy loam

31 to 41 inches—dark yellowish brown, mottled sandy loam

41 to 45 inches—brown, mottled sandy loam

45 to 60 inches—dark yellowish brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Special characteristics: A root-restricting layer at a depth of 45 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils, which have a sandy mantle 20 to 40 inches thick over dense till; in the higher landscape positions
- The very poorly drained Runeberg soils in depressions and swales

Similar soils:

- Soils that have a surface layer of loam, fine sandy loam, or loamy sand
- Soils that have a sandy subsurface layer
- Soils that have cobbles and boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table

- The major crops are oats, barley, and corn for silage.
- Wetness limits the choice of plants, restricts the period of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen and northern red oak. Species of limited extent are white spruce, black ash, American elm, white oak, and green ash.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods.
- Using wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 2w

Woodland ordination symbol: 4W

Windbreak suitability group: 1

1160B—Redeye loamy sand, acid substratum, 1 to 6 percent slopes

Composition

Redeye soil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane or slightly convex side slopes and shoulder slopes on drumlins

Shape of areas: Ovoid, elongated, or moderately long and moderately wide with smooth edges

Size of areas: 5 to 100 acres

Typical Profile

0 to 6 inches—very dark grayish brown loamy sand

6 to 15 inches—dark brown loamy fine sand
 15 to 21 inches—dark yellowish brown loamy sand
 21 to 33 inches—yellowish brown sand
 33 to 60 inches—yellowish brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—rapid; lower part—very slow
Available water capacity: Low
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: Greater than 6 feet
Special characteristics: A root-restricting layer at a depth of 55 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils on the more nearly level slopes
- The moderately well drained Blowers soils, which do not have a sandy mantle; on the more nearly level slopes
- Poorly drained, sandy soils adjacent to drainageways

Similar soils:

- Soils in which the sandy mantle is slightly thicker or thinner
- Soils in areas that have slopes of 6 to 12 percent
- Soils that have a surface soil of sandy loam
- Soils that have small pockets of sand or sand and gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, and growing a cover crop reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur

oak, bigtooth aspen, and northern red oak.

- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 6S

Windbreak suitability group: 5

1160C—Redeye loamy sand, acid substratum, 6 to 12 percent slopes

Composition

Redeye soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane to convex side slopes and shoulder slopes on drumlins

Shape of areas: Ovoid, elongated, or short and narrow with smooth edges

Size of areas: 5 to 60 acres

Typical Profile

0 to 7 inches—dark brown loamy sand
 7 to 14 inches—dark yellowish brown loamy sand
 14 to 22 inches—dark brown loamy sand
 22 to 27 inches—dark yellowish brown loamy sand
 27 to 60 inches—dark yellowish brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—rapid; lower part—very slow
Available water capacity: Low
Organic matter content: Moderately low or moderate
Surface runoff: Medium
Depth to the water table: Greater than 6 feet
Special characteristics: A root-restricting layer at a depth of 44 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Blowers soils, which are sandy loam throughout; in the less sloping areas
- The moderately well drained Huntersville soils in the less sloping areas

- Poorly drained sands and gravel on toe slopes adjacent to drainageways

Similar soils:

- Soils in which the sandy mantle is slightly thicker or thinner
- Soils in areas that have slopes of 1 to 6 percent
- Soils that have a surface soil of sandy loam
- Small areas of soils that have sand or sand and gravel in the underlying material

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, water erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Maintaining crop residue on the surface, planting field windbreaks, maintaining a plant cover, and growing a cover crop reduce the hazards of wind erosion and water erosion.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Careful irrigation helps to prevent the development of a perched water table.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are quaking aspen, red pine, and jack pine. Species of limited extent are bur oak, bigtooth aspen, and northern red oak.
- Because of droughtiness, seedling mortality is a concern. Special site preparation, such as scalping before planting, reduces the seedling mortality rate.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Because the surface layer becomes loose during dry periods, the use of equipment is limited. Maintaining the surface mat helps to overcome this limitation.
- Using specialized or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 6S

Windbreak suitability group: 5

1943—Roscommon loamy sand

Composition

Roscommon soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions, drainageways, and toe slopes on outwash plains and till-floored glacial lake plains

Slope range: 0 to 2 percent

Shape of areas: Elongated or circular

Size of areas: 5 to 50 acres

Typical Profile

0 to 6 inches—very dark gray loamy sand

6 to 24 inches—brown, mottled sand

24 to 60 inches—gray, mottled sand

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: High or very high

Surface runoff: Slow

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils on rises
- The very poorly drained Markey soils, which have organic layers over sandy material
- The somewhat poorly drained Meehan soils in the higher landscape positions

Similar soils:

- Soils that are somewhat poorly drained
- Soils that have a surface layer of sandy loam, sand, fine sand, coarse sand, or mucky sand
- Soils that have a loamy subsurface layer

Use and Management

Pasture and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- Wetness limits the choice of plants and the period of grazing.
- Rotating grazing, mowing and clipping, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and black ash. Species of limited extent are black spruce,

tamarack, and northern whitecedar.

- Seasonal wetness results in a high seedling mortality rate.
- The availability of landing sites is severely limited because of wetness.
- Only trees and shrubs that tolerate wetness should be planted.
- The soil is usually wet from fall to spring and can be wet during other periods. Equipment can be used only during dry periods in the summer and during winter when the snow cover is adequate.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.

Interpretive Groups

Land capability classification: 6w

Woodland ordination symbol: 3W

Windbreak suitability group: 10

1956—Staples loamy sand

Composition

Staples soil and similar soils: 85 to 95 percent

Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Plane and slightly convex areas on foot slopes and in depressions on drumlins

Slope range: 0 to 2 percent

Shape of areas: Elongated

Size of areas: 5 to 25 acres

Typical Profile

0 to 7 inches—very dark gray, mottled loamy sand

7 to 36 inches—very dark grayish brown and grayish brown, mottled sand

36 to 60 inches—olive gray, mottled sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 0.5 foot to 2.0 feet

Special characteristics: A root-restricting layer at a depth of 44 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Huntersville soils in the higher landscape positions
- The very poorly drained Cathro soils, which have organic layers over loamy material
- The very poorly drained Markey soils, which have organic layers over sandy material
- The somewhat poorly drained Paddock soils, which are loamy throughout; in the slightly higher landscape positions

Similar soils:

- Soils that have a thicker or thinner sandy mantle
- Soils that have a surface layer of sandy loam or sand
- Soils that have boulders on the surface

Use and Management

Cropland, pasture, and forage

Major management factors: Seasonal high water table, available water capacity, wind erosion

- The major crops are oats and corn for silage.
- Wetness limits the choice of plants and the period of grazing.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rotation grazing, mowing and clipping, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality, windthrow

- The principal tree species are quaking aspen and northern red oak. Species of limited extent are black ash, jack pine, white oak, and American elm.
- Because of the seasonal high water table, trees on this soil are shallow rooted. Many trees may be blown down during periods of high winds and excessive wetness.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Because of droughtiness, seasonal wetness, and the restricted rooting depth, seedling mortality is a concern.

Using special planting stock or containerized seedlings can reduce the seedling mortality rate.

Interpretive Groups

Land capability classification: 3w

Woodland ordination symbol: 6W

Windbreak suitability group: 2

1957B—Friendship loamy sand, loamy substratum, 1 to 6 percent slopes

Composition

Friendship soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Foot slopes and summits on outwash plains, drumlins, and moraines

Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 10 to 250 acres

Typical Profile

0 to 8 inches—very dark grayish brown loamy sand

8 to 18 inches—brown loamy sand

18 to 26 inches—yellowish brown sand

26 to 34 inches—yellowish brown, mottled sand

34 to 40 inches—strong brown, mottled sand

40 to 48 inches—brown, mottled sand

48 to 60 inches—yellowish brown, mottled loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—moderate or moderately slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 3 to 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Blowers soils, which are loamy throughout; in the slightly higher landscape positions
- The very poorly drained Roscommon soils in depressions and drainageways

Similar soils:

- Soils that are sandy throughout
- Soils that are somewhat poorly drained
- Soils that have a surface layer of sand, loamy fine sand, or fine sand
- Soils that contain 10 to 35 percent gravel in the sandy material

- Soils that have loamy material above a depth of 40 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, seedling mortality

- The principal tree species are jack pine, red pine, and quaking aspen.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 7S

Windbreak suitability group: 7

1970B—Menahga loamy sand, till substratum, 2 to 8 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on drumlins and moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 40 to 200 acres

Typical Profile

0 to 4 inches—very dark gray loamy sand
 4 to 9 inches—dark grayish brown loamy sand
 9 to 49 inches—yellowish brown sand
 49 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 49 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils that have a loamy substratum or are sandy throughout; in the lower landscape positions

Similar soils:

- Soils that contain 10 to 35 percent gravel in the sandy material
- Soils that have loamy material above a depth of 40 inches
- Soils that have a surface layer of sand, loamy coarse sand, or coarse sand
- Soils in areas that have slopes of 8 to 15 percent
- Soils that are sandy throughout

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Careful irrigation helps to prevent the development of a perched water table.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, and jack pine. Species of limited extent are northern red oak and bur oak.

- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

1970C—Menahga loamy sand, till substratum, 8 to 15 percent slopes

Composition

Menahga soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulder slopes on drumlins and moraines

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 20 to 80 acres

Typical Profile

0 to 3 inches—very dark gray loamy sand
 3 to 7 inches—brown sand
 7 to 48 inches—yellowish brown sand
 48 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Special characteristics: A root-restricting layer at a depth of 48 inches

Inclusions

Contrasting inclusions:

- The moderately well drained Friendship soils that have

a loamy substratum; in the lower landscape positions

- The moderately well drained Friendship soils that are sandy throughout; in the slightly lower landscape positions

Similar soils:

- Soils that contain 10 to 35 percent gravel in the sandy material
- Soils that have loamy material above a depth of 40 inches
- Soils that have a surface layer of sand, loamy coarse sand, or coarse sand
- Soils in areas that have slopes of 2 to 8 percent
- Soils that are sandy throughout

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, water erosion

- The major crops are oats, corn for silage, and forage.
- Crops that tolerate drought are best suited. The available moisture is not adequate for good growth of other crops.
- Maintaining crop residue on the surface, planting field windbreaks, using minimum tillage, and maintaining a plant cover reduce the hazard of erosion.
- Adjusting stocking rates, especially on the steeper slopes, rotating grazing, discouraging selective grazing, controlling weeds, and applying fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Seedling mortality

- The principal tree species are red pine, quaking aspen, and jack pine. Species of limited extent are northern red oak and bur oak.
- This soil is well suited to year-round logging.
- Cutting the timber or removing the understory increases the hazard of wind erosion.
- Avoiding excessive disturbance of the soil, stabilizing cuts with a grass straw mulch, and interplanting with a cover crop reduce the hazard of wind erosion.
- Using special planting stock or containerized seedlings can reduce the seedling mortality rate.
- Special site preparation, such as scalping before planting, also reduces the seedling mortality rate.
- Because the upper part of the soil becomes loose when dry, the use of wheeled and tracked equipment may be restricted.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.

Interpretive Groups

Land capability classification: 4s

Woodland ordination symbol: 6S

Windbreak suitability group: 7

1978—Nokay loam, very stony

Composition

Nokay soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Concave toe slopes, flats, and drainageways on drumlins

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 200 acres

Typical Profile

0 to 5 inches—black loam

5 to 17 inches—grayish brown, mottled sandy loam

17 to 60 inches—brown, mottled sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—very slow

Available water capacity: Moderate

Organic matter content: Moderate or high

Surface runoff: Slow

Depth to the water table: 1.0 to 2.5 feet

Special characteristics: A root-restricting layer at a depth of 33 inches; 0.1 to 3.0 percent of the surface covered with stones

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Cathro soils in wet depressions and drainageways
- The well drained Flak soils in the more sloping areas at the higher elevations
- The moderately well drained Wabedo soils on rises and in slightly elevated areas

Similar soils:

- Soils that have silty or sandy layers above the underlying material
- Soils that have a surface layer of loam or sandy loam

Use and Management

Pasture and forage

Major management factors: Available water capacity, seasonal high water table, rock fragments

- The major crops grown are forage crops.
- The underlying dense till restricts the growth of deep-rooted plants.
- Rock fragments on the surface severely hinder tillage

and the planting of row crops.

- Restricting grazing during wet periods helps to prevent compaction and poor tilth.
- Wetness limits the choice of plants, restricts the period of grazing, limits the production of deep-rooted crops, and increases the risk of winterkill.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: Equipment limitations, windthrow

- The principal tree species are quaking aspen, northern red oak, sugar maple, and American basswood.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.
- The use of equipment is restricted in spring and during other excessively wet periods. The upper part of the subsoil is saturated during these periods. The degree of saturation generally is higher on the lower parts of the slopes.
- After the trees are cut, plant competition can be expected to prevent natural regeneration unless precautionary measures are applied.
- Adequate site preparation controls initial plant competition, and spraying controls subsequent growth.
- Because of the dense layer in the lower part of the subsoil, trees on this soil are shallow rooted. Some may be blown down during periods of high winds and excessive wetness.
- Rock fragments on the surface may hinder the use of equipment.

Interpretive Groups

Land capability classification: 6s

Woodland ordination symbol: 5X

Windbreak suitability group: 1

1995B—Bergkeller sandy loam, 1 to 6 percent slopes

Composition

Bergkeller soil and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Broad flats on moraines

Shape of areas: Broad or slightly elongated

Size of areas: 35 to 250 acres

Typical Profile

1 inch to 0—black, moderately decomposed forest litter

0 to 3 inches—black sandy loam

3 to 10 inches—dark yellowish brown sandy loam

10 to 21 inches—dark yellowish brown loamy sand

21 to 32 inches—dark yellowish brown sandy loam

32 to 40 inches—strong brown sand

40 to 60 inches—yellowish brown gravelly coarse sand

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Sanburn soils in the higher, more sloping landscape positions
- The excessively drained Menahga and Mahtomedi soils in the more sloping areas
- The moderately well drained, moderately wet Cromwell soils, which have a thinner loamy cap than the Bergkeller soil; in the lower landscape positions

Similar soils:

- Soils that are moderately well drained
- Soils that have a surface layer of sand, loamy sand, loamy coarse sand, or fine sandy loam
- Soils that have a higher clay content in the subsoil

Use and Management

Cropland, pasture, and forage

Major management factors: Wind erosion, available water capacity

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.

Woodland

Major management factors: None

- The principal tree species are red pine, jack pine, and bigtooth aspen. Species of limited extent are paper birch and bur oak.
- Unless the site is adequately prepared, competition from undesirable plants can prevent or delay natural or artificial reestablishment of trees.
- Using suitable harvest methods, laying out skid trails in advance, and harvesting under the proper moisture conditions help to prevent surface compaction.

Interpretive Groups

Land capability classification: 3e

Woodland ordination symbol: 7A

Windbreak suitability group: 6G

1996—Cromwell sandy loam, moderately wet

Composition

Cromwell soil and similar soils: 90 to 95 percent

Contrasting inclusions: 5 to 10 percent

Setting

Landform and position on the landform: Toe slopes and foot slopes on outwash plains and moraines

Slope range: 0 to 2 percent

Shape of areas: Short and moderately wide with curvilinear edges

Size of areas: 5 to 70 acres

Typical Profile

2 inches to 0—black, moderately decomposed forest litter

0 to 3 inches—dark grayish brown sandy loam

3 to 8 inches—dark brown sandy loam

8 to 12 inches—yellowish brown sandy loam

12 to 17 inches—brown sandy loam

17 to 25 inches—yellowish brown sand

25 to 33 inches—yellowish brown coarse sand

33 to 41 inches—yellowish brown, mottled coarse sand

41 to 60 inches—brown sand

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 2.5 to 5.0 feet

Inclusions

Contrasting inclusions:

- The excessively drained Cromwell soils in the higher landscape positions and the more sloping areas
- The very poorly drained Roscommon soils, which are sandy throughout; in the lower landscape positions
- The somewhat poorly drained Watab soils, which have loamy material within a depth of 20 to 40 inches; in landscape positions similar to those of the Cromwell soil

Similar soils:

- Soils that have a surface layer of sand, fine sandy loam, or loamy sand
- Soils that have a thicker or thinner loamy mantle

- Soils that have thin sandy layers within the loamy mantle
- Soils that have thin bands of loamy material in the lower part of the subsoil
- Soils that have loamy materials below a depth of 40 inches

Use and Management

Cropland, pasture, and forage

Major management factors: Available water capacity, wind erosion, seasonal high water table

- The major crops are oats, corn for silage, and forage.
- Planting field windbreaks and returning crop residue to the soil conserve moisture.
- Chisel plowing, using minimum tillage, and installing grassed waterways and diversions reduce the hazard of wind erosion.
- Rotation grazing, weed control, and yearly applications of fertilizer help to maintain the quality and quantity of forage.
- Wetness limits the choice of plants and the period of grazing.
- Restricting grazing during wet periods helps to prevent compaction and poor tilth.

Woodland

Major management factors: None

- The principal tree species are red pine, quaking aspen, paper birch, northern red oak, and balsam fir. Species of limited extent are American basswood, eastern white pine, and jack pine.
- If openings are made in the canopy, invading plants can prevent natural or artificial regeneration of desirable species.
- Seedlings grow well if competing vegetation is controlled with herbicides or by mechanical removal.

Interpretive Groups

Land capability classification: 3s

Woodland ordination symbol: 7A

Windbreak suitability group: 7

Descriptions of Soils in the Chippewa National Forest

A10—Glossaqualfs

Composition

Glossaqualfs and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 40 to 150 acres

Sample Profile

1 inch to 0—slightly decomposed forest litter
 0 to 3 inches—very dark gray loam
 3 to 9 inches—light brownish gray, mottled fine sandy loam
 9 to 28 inches—grayish brown, mottled fine sandy loam and dark grayish brown, mottled clay loam
 28 to 36 inches—light brownish gray, mottled loam
 36 to 60 inches—light brownish gray, mottled sandy loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained or poorly drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate or moderately slow

Available water capacity: Moderate or high

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- Very poorly drained mineral soils in swales and depressions

Similar soils:

- Soils that have layers of silt loam or silty clay loam in the subsoil and underlying material
- Soils that are better drained

A12—Warba-Aquic Eutroboralfs, loamy-Aeric Glossaqualfs, loamy, association, nearly level to gently rolling

Composition

Warba soil and similar soils: 35 to 40 percent

Aquic Eutroboralfs and similar soils: 20 to 30 percent

Aeric Glossaqualfs and similar soils: 15 to 25 percent

Contrasting inclusions: 20 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes, shoulders, and summits on moraines; Aquic Eutroboralfs—plane or slightly convex side slopes on moraines; Aeric Glossaqualfs—plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: Warba—0 to 10 percent; Aquic

Eutroboralfs—0 to 2 percent; Aeric Glossaqualfs—0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 40 to 250 acres

Sample Profile

Warba

0 to 1 inch—black very fine sandy loam
 1 to 3 inches—dark grayish brown fine sandy loam
 3 to 9 inches—yellowish brown fine sandy loam
 9 to 14 inches—light brownish gray fine sandy loam
 14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
 18 to 28 inches—olive brown loam
 28 to 36 inches—olive brown clay loam
 36 to 40 inches—light olive brown clay loam
 40 to 60 inches—light olive brown loam

Aquic Eutroboralfs

0 to 6 inches—light gray loamy fine sand
 6 to 12 inches—pale brown, mottled loamy fine sand
 12 to 17 inches—dark yellowish brown, mottled fine sandy loam
 17 to 31 inches—dark grayish brown, mottled clay loam
 31 to 37 inches—brown, mottled clay loam
 37 to 60 inches—light brownish gray clay loam

Aeric Glossaqualfs

0 to 5 inches—gray fine sandy loam
 5 to 9 inches—brown fine sandy loam
 9 to 13 inches—yellowish brown, mottled fine sandy loam
 13 to 24 inches—about 60 percent gray, mottled fine sandy loam and 40 percent dark brown, mottled clay loam
 24 to 35 inches—dark yellowish brown, mottled clay loam
 35 to 60 inches—dark brown, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Aquic Eutroboralfs—moderately well drained; Aeric Glossaqualfs—somewhat poorly drained

Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Aquic Eutroboralfs—moderate in the upper part, moderately slow in the lower part; Aeric Glossaqualfs—moderately rapid or moderate in the upper part, moderate to slow in the lower part

Available water capacity: Warba—high; Aquic Eutroboralfs—high; Aeric Glossaqualfs—high

Organic matter content: Moderately low or moderate

Surface runoff: Warba—slow or medium; Aquic Eutroboralfs—slow; Aeric Glossaqualfs—slow

Depth to the water table: Warba—greater than 6 feet;

Aquic Eutroboralfs—2 to 6 feet; Aerio
Glossaqualfs—1 to 3 feet

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Cathro soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the major soils
- Very poorly drained mineral soils in depressions and drainageways

Similar soils:

- Soils that have slightly more clay in the subsoil

A13—Warba-Aquic Eutroboralfs, loamy-Aeric Glossaqualfs, loamy, association, nearly level to hilly

Composition

Warba soil and similar soils: 35 to 40 percent
Aquic Eutroboralfs and similar soils: 20 to 30 percent
Aeric Glossaqualfs and similar soils: 15 to 25 percent
Contrasting inclusions: 20 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes on moraines; Aquic Eutroboralfs—plane or slightly convex side slopes on moraines; Aeric Glossaqualfs—plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: Warba—10 to 25 percent; Aquic Eutroboralfs—0 to 2 percent; Aeric Glossaqualfs—0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 40 to 250 acres

Sample Profile

Warba

0 to 1 inch—black very fine sandy loam
1 to 3 inches—dark grayish brown fine sandy loam
3 to 9 inches—yellowish brown fine sandy loam
9 to 14 inches—light brownish gray fine sandy loam
14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
18 to 28 inches—olive brown loam
28 to 36 inches—olive brown clay loam
36 to 40 inches—light olive brown clay loam
40 to 60 inches—light olive brown loam

Aquic Eutroboralfs

0 to 6 inches—light gray loamy fine sand
6 to 12 inches—pale brown, mottled loamy fine sand
12 to 17 inches—dark yellowish brown, mottled fine sandy loam
17 to 31 inches—dark grayish brown, mottled clay loam
31 to 37 inches—brown, mottled clay loam
37 to 60 inches—light brownish gray clay loam

Aeric Glossaqualfs

0 to 5 inches—gray fine sandy loam
5 to 9 inches—brown fine sandy loam
9 to 13 inches—yellowish brown, mottled fine sandy loam
13 to 24 inches—about 60 percent gray, mottled fine sandy loam and 40 percent dark brown, mottled clay loam
24 to 35 inches—dark yellowish brown, mottled clay loam
35 to 60 inches—dark brown, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Aquic Eutroboralfs—moderately well drained; Aeric Glossaqualfs—somewhat poorly drained

Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Aquic Eutroboralfs—moderate in the upper part, moderately slow in the lower part; Aeric Glossaqualfs—moderately rapid or moderate in the upper part, moderate to slow in the lower part

Available water capacity: Warba—high; Aquic Eutroboralfs—high; Aeric Glossaqualfs—high

Organic matter content: Moderately low or moderate

Surface runoff: Warba—rapid; Aquic Eutroboralfs—slow; Aeric Glossaqualfs—slow

Depth to the water table: Warba—greater than 6 feet; Aquic Eutroboralfs—2 to 6 feet; Aeric Glossaqualfs—1 to 3 feet

Inclusions

Contrasting inclusions:

- The very poorly drained, organic Cathro soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the major soils
- Very poorly drained mineral soils in depressions and drainageways

Similar soils:

- Soils that have slightly more clay in the subsoil

A15—Typic Udipsamments-Arenic Eutroboralfs-Alfic Udipsamments association, nearly level to gently rolling

Composition

Typic Udipsamments and similar soils: 35 to 45 percent
 Arenic Eutroboralfs and similar soils: 15 to 25 percent
 Alfic Udipsamments and similar soils: 15 to 25 percent
 Contrasting inclusions: 20 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines
Slope range: 0 to 10 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 15 to 450 acres

Sample Profile

Typic Udipsamments

0 to 2 inches—dark brown loamy sand
 2 to 6 inches—pale brown loamy sand
 6 to 16 inches—yellowish brown loamy sand
 16 to 22 inches—very pale brown sand
 22 to 60 inches—light yellowish brown sand

Arenic Eutroboralfs

2 inches to 0—slightly decomposed forest litter
 0 to 1 inch—very dark gray loamy fine sand
 1 to 6 inches—dark grayish brown loamy fine sand
 6 to 10 inches—dark brown loamy fine sand
 10 to 20 inches—brown loamy fine sand
 20 to 30 inches—yellowish brown sand
 30 to 36 inches—dark yellowish brown sandy loam
 36 to 60 inches—light olive brown silty clay loam

Alfic Udipsamments

2 inches to 0—partially decomposed forest litter
 0 to 1 inch—black loamy sand
 1 to 3 inches—grayish brown and dark grayish brown loamy sand
 3 to 7 inches—yellowish brown loamy fine sand
 7 to 17 inches—brown fine sand
 17 to 26 inches—light brownish gray fine sand
 26 to 58 inches—light brownish gray and brown fine sand and sand
 58 to 60 inches—light brownish gray sand

Soil Properties and Qualities

Drainage class: Typic Udipsamments—excessively drained; Arenic Eutroboralfs—well drained; Alfic Udipsamments—excessively drained
Permeability: Typic Udipsamments—rapid; Arenic Eutroboralfs—rapid in the upper part, slow or moderately slow in the lower part; Alfic Udipsamments—rapid

Available water capacity: Typic Udipsamments—low; Arenic Eutroboralfs—moderate; Alfic Udipsamments—low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the major soils
- Somewhat poorly drained soils on toe slopes and in drainageways
- Very poorly drained mineral and organic soils in depressions and drainageways

Similar soils:

- Soils that have a slightly thinner or thicker sandy mantle
- Soils that are moderately well drained

A16—Warba-Dystic Eutrochrepts-Typic Udipsamments association, nearly level to gently rolling

Composition

Warba soil and similar soils: 50 to 60 percent
 Dystic Eutrochrepts and similar soils: 10 to 20 percent
 Typic Udipsamments and similar soils: 10 to 15 percent
 Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and shoulders on moraines
Slope range: 0 to 10 percent
Shape of areas: Moderately wide and long with curvilinear edges
Size of areas: 15 to 600 acres

Sample Profile

Warba

0 to 1 inch—black very fine sandy loam
 1 to 3 inches—dark grayish brown fine sandy loam
 3 to 9 inches—yellowish brown fine sandy loam
 9 to 14 inches—light brownish gray fine sandy loam
 14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
 18 to 28 inches—olive brown loam
 28 to 36 inches—olive brown clay loam
 36 to 40 inches—light olive brown clay loam
 40 to 60 inches—light olive brown loam

Dystic Eutrochrepts

2 inches to 0—partially decomposed forest litter

0 to 3 inches—very dark gray loam
 3 to 13 inches—dark brown loam
 13 to 20 inches—brown loam
 20 to 33 inches—dark yellowish brown sandy loam
 33 to 46 inches—yellowish brown loamy fine sand
 46 to 60 inches—light yellowish brown loamy fine sand

Typic Udipsamments

0 to 2 inches—dark brown loamy sand
 2 to 6 inches—pale brown loamy sand
 6 to 16 inches—yellowish brown loamy sand
 16 to 22 inches—very pale brown sand
 22 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Warba—well drained; Dystric
 Eutrochrepts—well drained; Typic Udipsamments—
 excessively drained

Permeability: Warba—moderate in the upper part,
 moderately slow in the lower part; Dystric
 Eutrochrepts—moderate or moderately rapid in the
 upper part, rapid in the lower part; Typic
 Udipsamments—rapid

Available water capacity: Warba—high; Dystric
 Eutrochrepts—moderate; Typic Udipsamments—low

Organic matter content: Warba—moderately low or
 moderate; Dystric Eutrochrepts—low or moderately
 low; Typic Udipsamments—low or moderately low

Surface runoff: Warba—slow or medium; Dystric
 Eutrochrepts—slow; Typic Udipsamments—slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Hiwood soils, which are not banded; in the lower landscape positions
- The somewhat poorly drained Redby soils in the nearly level, lower lying areas
- Very poorly drained mineral soils in drainageways and depressions

A17—Menahga-Cutaway-Glossic Eutroboralfs association, rolling and hilly

Composition

Menahga soil and similar soils: 30 to 40 percent
 Cutaway soil and similar soils: 25 to 35 percent
 Glossic Eutroboralfs and similar soils: 15 to 25 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and
 shoulders on moraines

Slope range: 10 to 25 percent

Shape of areas: Moderately long and moderately

wide with curvilinear edges

Size of areas: 15 to 600 acres

Sample Profile

Menahga

0 to 1 inch—very dark gray loamy sand
 1 to 3 inches—grayish brown loamy sand
 3 to 22 inches—yellowish brown loamy sand
 22 to 30 inches—yellowish brown coarse sand
 30 to 60 inches—brown coarse sand

Cutaway

0 to 1 inch—very dark gray loamy sand
 1 to 2 inches—dark gray loamy sand
 2 to 9 inches—brown sand
 9 to 22 inches—light yellowish brown sand
 22 to 27 inches—pale brown sand
 27 to 31 inches—yellowish brown loamy sand and loam
 31 to 42 inches—brown loam
 42 to 48 inches—light olive brown sandy loam
 48 to 60 inches—light yellowish brown sandy loam

Glossic Eutroboralfs

0 to 1 inch—very dark gray very fine sandy loam
 1 to 6 inches—pale brown very fine sandy loam
 6 to 18 inches—yellowish brown very fine sandy loam
 18 to 23 inches—about 60 percent pale brown very fine
 sandy loam, tongued into and surrounding 40
 percent dark yellowish brown sandy loam
 23 to 26 inches—about 60 percent dark yellowish brown
 sandy loam, tongued into and surrounding 40
 percent pale brown very fine sandy loam
 26 to 48 inches—dark yellowish brown sandy loam
 48 to 56 inches—brown sandy loam
 56 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Menahga—excessively drained;
 Cutaway—well drained; Glossic Eutroboralfs—well
 drained

Permeability: Menahga—rapid; Cutaway—rapid in the
 upper part, slow or moderately slow in the lower
 part; Glossic Eutroboralfs—moderately rapid to
 moderately slow

Available water capacity: Menahga—low; Cutaway—
 moderate; Glossic Eutroboralfs—moderate

Organic matter content: Menahga—low or moderately
 low; Cutaway—low or moderately low; Glossic
 Eutroboralfs—moderately low or moderate

Surface runoff: Menahga—medium; Cutaway—medium;
 Glossic Eutroboralfs—medium or rapid

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy

throughout; in landscape positions similar to those of the major soils

A18—Arenic Eutroboralfs, nearly level to gently rolling

Composition

Arenic Eutroboralfs and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines
Slope range: 0 to 10 percent
Shape of areas: Moderately long and wide with curvilinear edges
Size of areas: 10 to 250 acres

Sample Profile

2 inches to 0—slightly decomposed forest litter
0 to 1 inch—very dark gray loamy fine sand
1 to 6 inches—dark grayish brown loamy fine sand
6 to 10 inches—dark brown loamy fine sand
10 to 20 inches—brown loamy fine sand
20 to 30 inches—yellowish brown sand
30 to 36 inches—dark yellowish brown sandy loam
36 to 60 inches—light olive brown silty clay loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Upper part—rapid; lower part—moderately slow or slow
Available water capacity: Moderate
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the Arenic Eutroboralfs
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the Arenic Eutroboralfs
- The somewhat poorly drained Stuntz soils, which are loamy throughout; on toe slopes and in drainageways

Similar soils:

- Soils that have a thinner or thicker sandy mantle
- Soils that are moderately well drained

A19—Menahga loamy coarse sand, moraine, rolling and hilly

Composition

Menahga soil and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes, shoulders, and ridges on moraines
Slope range: 10 to 25 percent
Shape of areas: Long and narrow with curvilinear edges
Size of areas: 15 to 300 acres

Sample Profile

0 to 3 inches—very dark grayish brown loamy coarse sand
3 to 5 inches—dark yellowish brown loamy sand
5 to 20 inches—yellowish brown sand
20 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow or medium
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Cutaway soils, which have a sandy mantle 20 to 40 inches thick; in landscape positions similar to those of the Menahga soil
- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the Menahga soil

Similar soils:

- Soils that have a surface layer of sand

A20—Typic Udipsamments, gravelly, rolling to very hilly

Composition

Typic Udipsamments and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes, shoulders, and summits on outwash plains and moraines
Slope range: 15 to 40 percent
Shape of areas: Long and moderately wide with curvilinear edges

Size of areas: 5 to 40 acres

Typical Profile

3 inches to 0—very dark grayish brown, moderately decomposed forest litter
 0 to 2 inches—very dark grayish brown loamy sand
 2 to 6 inches—dark yellowish brown loamy sand
 6 to 12 inches—dark yellowish brown loamy coarse sand
 12 to 20 inches—dark yellowish brown coarse sand
 20 to 22 inches—yellowish brown gravelly sand
 22 to 60 inches—light yellowish brown gravelly coarse sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Well drained soils that have loamy till in the underlying material

Similar soils:

- Soils that have bands of loamy material within a depth of 60 inches

E57—Zimmerman loamy fine sand, nearly level and undulating

Composition

Zimmerman soil and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Plane and slightly convex back slopes, shoulders, and summits on outwash plains and lake plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 450 acres

Sample Profile

0 to 1 inch—very dark grayish brown loamy fine sand
 1 to 4 inches—dark gray fine sand
 4 to 9 inches—dark yellowish brown fine sand
 9 to 16 inches—light yellowish brown fine sand
 16 to 26 inches—yellowish brown fine sand
 26 to 41 inches—pale brown fine sand
 41 to 60 inches—pale brown fine sand and thin bands

of brown loamy fine sand

Soil Properties and Qualities

Drainage class: Excessively drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The moderately well drained Hiwood soils in the slightly lower landscape positions
- Very poorly drained mineral soils in depressions and drainageways
- Very poorly drained organic soils in depressions
- Somewhat poorly drained soils in the lower landscape positions

Similar soils:

- Soils that have layers of very fine sand
- Soils that are well drained

E58—Graycalm-Typic Udipsamments association, nearly level and undulating

Composition

Graycalm soil and similar soils: 45 to 55 percent
 Typic Udipsamments and similar soils: 30 to 40 percent
 Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines and outwash plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 450 acres

Sample Profile

Graycalm

0 to 5 inches—very dark gray loamy sand
 5 to 9 inches—dark yellowish brown loamy sand
 9 to 32 inches—yellowish brown sand
 32 to 46 inches—light yellowish brown sand that has several thin bands of dark yellowish brown loamy sand
 46 to 60 inches—pale brown sand

Typic Udipsamments

0 to 3 inches—very dark grayish brown loamy sand
 3 to 36 inches—yellowish brown sand
 36 to 60 inches—light yellowish brown coarse sand and sand

Soil Properties and Qualities

Drainage class: Graycalm—somewhat excessively drained; Typic Udipsamments—excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which have more clay in the subsoil and underlying material than the major soils; on isolated swells
- The moderately well drained Hiwood soils, which are not banded; in the lower landscape positions
- The somewhat poorly drained Redby soils in the nearly level, lower lying areas
- Very poorly drained mineral soils in drainageways and depressions

Similar soils:

- Soils that are loamy in the underlying material

E59—Warba-Stuntz-Arenic Eutroboralfs association, nearly level and undulating

Composition

Warba soil and similar soils: 35 to 40 percent

Stuntz soil and similar soils: 30 to 35 percent

Arenic Eutroboralfs and similar soils: 15 to 20 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Warba—plane to convex side slopes on moraines; Stuntz—plane or slightly concave toe slopes, depressions, and drainageways on moraines; Arenic Eutroboralfs—convex side slopes and summits on moraines

Slope range: Warba—1 to 8 percent; Stuntz—0 to 2 percent; Arenic Eutroboralfs—0 to 8 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 10 to 250 acres

Sample Profile

Warba

- 0 to 2 inches—very dark brown fine sandy loam
- 2 to 12 inches—brown fine sandy loam
- 12 to 16 inches—brown fine sandy loam tonguing into dark yellowish brown loam
- 16 to 22 inches—dark yellowish brown clay loam with interfingerings of brown fine sandy loam
- 22 to 35 inches—dark yellowish brown clay loam

35 to 60 inches—light olive brown, calcareous loam

Stuntz

- 1 inch to 0—black, slightly decomposed forest litter
- 0 to 1 inch—very dark gray silt loam
- 1 to 5 inches—grayish brown and light grayish brown very fine sandy loam
- 5 to 10 inches—light brownish gray, mottled very fine sandy loam
- 10 to 17 inches—grayish brown, mottled very fine sandy loam and olive brown and grayish brown, mottled sandy clay loam
- 17 to 22 inches—olive brown, mottled sandy clay loam and grayish brown, mottled very fine sandy loam
- 22 to 27 inches—olive brown, mottled sandy clay loam
- 27 to 34 inches—light olive brown, mottled clay loam
- 34 to 39 inches—light olive brown, mottled loam
- 39 to 60 inches—light olive brown loam

Arenic Eutroboralfs

- 0 to 1 inch—very dark gray loamy fine sand
- 1 to 6 inches—dark grayish brown loamy fine sand
- 6 to 10 inches—dark brown loamy fine sand
- 10 to 20 inches—brown loamy fine sand
- 20 to 30 inches—yellowish brown sand
- 30 to 36 inches—dark yellowish brown sandy loam
- 36 to 60 inches—light olive brown silty clay loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Stuntz—somewhat poorly drained; Arenic Eutroboralfs—well drained

Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Stuntz—moderately rapid in the upper part, moderately slow in the lower part; Arenic Eutroboralfs—rapid in the upper part, moderately slow in the lower part

Available water capacity: Warba—high; Stuntz—high; Arenic Eutroboralfs—moderate

Organic matter content: Warba—moderate; Stuntz—moderately low or moderate; Arenic Eutroboralfs—low or moderately low

Surface runoff: Warba—slow or medium; Stuntz—slow; Arenic Eutroboralfs—slow

Depth to the water table: Warba—greater than 6 feet; Stuntz—1.5 to 3.0 feet; Arenic Eutroboralfs—greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained mineral soils in shallow depressions
- Very poorly drained organic soils in the deeper depressions
- Somewhat poorly drained soils that are sandy

throughout or are underlain by loamy material

Similar soils:

- Soils that are moderately well drained

E60—Warba-Stuntz association, nearly level and undulating

Composition

Warba soil and similar soils: 40 to 45 percent

Stuntz soil and similar soils: 35 to 40 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes and summits on moraines; Stuntz—plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: Warba—1 to 8 percent; Stuntz—0 to 2 percent

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 15 to 1,000 acres

Sample Profile

Warba

0 to 1 inch—black very fine sandy loam

1 to 3 inches—dark grayish brown fine sandy loam

3 to 9 inches—yellowish brown fine sandy loam

9 to 14 inches—light brownish gray fine sandy loam

14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam

18 to 28 inches—olive brown loam

28 to 36 inches—olive brown clay loam

36 to 40 inches—light olive brown clay loam

40 to 60 inches—light olive brown loam

Stuntz

1 inch to 0—black, slightly decomposed forest litter

0 to 1 inch—very dark gray silt loam

1 to 5 inches—grayish brown and light grayish brown very fine sandy loam

5 to 10 inches—light brownish gray, mottled very fine sandy loam

10 to 17 inches—grayish brown, mottled very fine sandy loam and olive brown and grayish brown, mottled sandy clay loam

17 to 22 inches—olive brown, mottled sandy clay loam and grayish brown, mottled very fine sandy loam

22 to 27 inches—olive brown, mottled sandy clay loam

27 to 34 inches—light olive brown, mottled clay loam

34 to 39 inches—light olive brown, mottled loam

39 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Warba—well drained; Stuntz—somewhat poorly drained

Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part; Stuntz—moderately rapid in the upper part, moderately slow in the lower part

Available water capacity: High

Organic matter content: Warba—moderate; Stuntz—moderately low or moderate

Surface runoff: Warba—slow or medium; Stuntz—slow

Depth to the water table: Warba—greater than 6 feet; Stuntz—1.5 to 3.0 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- Well drained soils that have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils

E61—Glossic Eutroboralfs, loamy, rolling and hilly

Composition

Glossic Eutroboralfs and similar soils: 75 to 85 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and shoulders on moraines

Slope range: 8 to 20 percent

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 15 to 500 acres

Sample Profile

0 to 1 inch—very dark gray very fine sandy loam

1 to 6 inches—pale brown very fine sandy loam

6 to 18 inches—yellowish brown very fine sandy loam

18 to 23 inches—pale brown very fine sandy loam and dark yellowish brown sandy loam

23 to 26 inches—dark yellowish brown sandy loam and pale brown very fine sandy loam

26 to 48 inches—dark yellowish brown sandy loam

48 to 56 inches—brown sandy loam

56 to 60 inches—dark brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Moderately rapid to moderately slow

Available water capacity: High

Organic matter content: Moderate

Surface runoff: Rapid

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils
- The somewhat poorly drained Stuntz soils on toe slopes and in swales

Similar soils:

- A few areas of soils that are sandy in the underlying material
- Small areas of soils that have slightly more clay in the subsoil

E62—Warba-Histosols association, nearly level to gently rolling

Composition

Warba soil and similar soils: 45 to 55 percent

Histosols and similar soils: 30 to 35 percent

Contrasting inclusions: 10 to 25 percent

Setting

Landform and position on the landform: Warba—side slopes, shoulders, and summits on moraines;
Histosols—depressions on moraines

Slope range: Warba—1 to 12 percent; Histosols—0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 40 to 200 acres

Sample Profile

Warba

0 to 2 inches—very dark brown fine sandy loam

2 to 12 inches—brown fine sandy loam

12 to 16 inches—brown fine sandy loam tonguing into dark yellowish brown loam

16 to 22 inches—dark yellowish brown clay loam with interfingerings of brown fine sandy loam

22 to 35 inches—dark yellowish brown clay loam

35 to 60 inches—light olive brown, calcareous loam

Histosols

0 to 17 inches—black mucky peat

17 to 32 inches—very dark gray mucky peat

32 to 45 inches—dark brown muck

45 to 60 inches—black muck

Soil Properties and Qualities

Drainage class: Warba—well drained; Histosols—very poorly drained

Permeability: Warba—moderate in the upper part, moderate or moderately slow in the lower part;
Histosols—moderately slow to rapid

Available water capacity: Warba—high; Histosols—very high

Organic matter content: Warba—moderate; Histosols—very high

Surface runoff: Warba—medium or rapid; Histosols—very slow

Seasonal high water table: Warba—at a depth of more than 6 feet; Histosols—2 feet above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils
- The somewhat poorly drained Stuntz soils on toe slopes or in swales
- The excessively drained Menahga soils, which are sandy throughout; in landscape positions similar to those of the major soils
- Very poorly drained, sandy soils on edges of depressions

Similar soils:

- Soils that have slightly more clay in the subsoil
- Soils that are moderately well drained

E63—Aquic Eutroboralfs, clayey subsoil, nearly level and undulating

Composition

Aquic Eutroboralfs and similar soils: 75 to 85 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines

Slope range: 8 to 20 percent

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 20 to 80 acres

Sample Profile

0 to 2 inches—very dark grayish brown loam

2 to 6 inches—light brownish gray loam

6 to 14 inches—dark yellowish brown, mottled clay

14 to 23 inches—dark brown, mottled clay

23 to 60 inches—grayish brown, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderately slow or slow
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Medium
Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- Very poorly drained mineral soils in swales and depressions
- The somewhat poorly drained Aeric Glossaqualfs on foot slopes and toe slopes

Similar soils:

- Soils that have less clay in the subsoil
- Soils that are well drained

E65—Aeric Glossaqualfs, loamy

Composition

Aeric Glossaqualfs and similar soils: 75 to 85 percent
 Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Plane or slightly concave toe slopes, depressions, and drainageways on moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 500 acres

Sample Profile

2 inches to 0—partially decomposed forest litter
 0 to 4 inches—very dark gray silt loam
 4 to 15 inches—light brownish gray fine sandy loam
 15 to 19 inches—about 60 percent light gray fine sandy loam and 40 percent dark yellowish brown fine sandy loam
 19 to 23 inches—dark yellowish brown and light brownish gray sandy loam
 23 to 29 inches—brown, mottled loam
 29 to 35 inches—dark yellowish brown, mottled clay loam
 35 to 41 inches—brown, mottled silty clay loam
 41 to 60 inches—grayish brown, mottled silt loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate to slow

Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- Very poorly drained mineral soils in swales and depressions

Similar soils:

- Soils that have layers of silt loam or silty clay loam in the subsoil and underlying material
- A few areas of soils in which the water table is closer to the surface

F76—Warba very fine sandy loam, nearly level and undulating

Composition

Warba soil and similar soils: 75 to 85 percent
 Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on moraines

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 1,000 acres

Sample Profile

0 to 1 inch—black very fine sandy loam
 1 to 3 inches—dark grayish brown fine sandy loam
 3 to 9 inches—yellowish brown fine sandy loam
 9 to 14 inches—light brownish gray fine sandy loam
 14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
 18 to 28 inches—olive brown loam
 28 to 36 inches—olive brown clay loam
 36 to 40 inches—light olive brown clay loam
 40 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow or moderate

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the Warba soil
- The somewhat poorly drained Stuntz soils on toe slopes or in swales

Similar soils:

- Soils that have slightly more clay in the subsoil
- Soils that are moderately well drained

F77—Warba very fine sandy loam, rolling and hilly

Composition

Warba soil and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and shoulders on moraines

Slope range: 8 to 25 percent

Shape of areas: Long and narrow with lobate edges

Size of areas: 15 to 500 acres

Sample Profile

- 0 to 1 inch—black very fine sandy loam
- 1 to 3 inches—dark grayish brown fine sandy loam
- 3 to 9 inches—yellowish brown fine sandy loam
- 9 to 14 inches—light brownish gray fine sandy loam
- 14 to 18 inches—light brownish gray fine sandy loam and dark yellowish brown loam
- 18 to 28 inches—olive brown loam
- 28 to 36 inches—olive brown clay loam
- 36 to 40 inches—light olive brown clay loam
- 40 to 60 inches—light olive brown loam

Soil Properties and Qualities

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow or moderate

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the Warba soil

- The somewhat poorly drained Stuntz soils on toe slopes and in swales

Similar soils:

- A few areas of soils that are sandy in the underlying material
- Small areas of soils that have slightly more clay in the subsoil
- Soils that have a sandy subsurface layer

K22—Alfic Udipsamments, nearly level and undulating

Composition

Alfic Udipsamments and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains and lake plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 10 to 100 acres

Typical Profile

- 0 to 4 inches—grayish brown loamy sand
- 4 to 28 inches—yellowish brown and brown sand
- 28 to 42 inches—light yellowish brown sand
- 42 to 60 inches—light yellowish brown sand, brownish yellow sand, and bands of yellowish brown sandy loam and dark brown fine sandy loam

Soil Properties and Qualities

Drainage class: Somewhat excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

Contrasting inclusions:

- The well drained Cutaway soils, which have more clay in the subsoil and underlying material than the major soils; on isolated swells
- The moderately well drained Hiwood soils, which are not banded; in the lower landscape positions
- The somewhat poorly drained Redby soils in the nearly level, lower lying areas

Similar soils:

- Soils that do not have thin bands of finer textured material
- Soils in which the total accumulation of bands of finer textured material is more than 6 inches

- Soils that have more clay in the surface layer

K25—Eutroboralfs-Typic Ochraqualfs association, nearly level and undulating

Composition

Eutroboralfs and similar soils: 45 to 55 percent

Typic Ochraqualfs and similar soils: 35 to 45 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Eutroboralfs—side slopes and summits on lake plains; Typic Ochraqualfs—plane or slightly concave toe slopes, depressions, and drainageways on lake plains

Slope range: Eutroboralfs—0 to 8 percent; Typic

Ochraqualfs—0 to 2 percent

Shape of areas: Moderately long and wide with smooth edges

Size of areas: 15 to 1,000 acres

Sample Profile

Eutroboralfs

0 to 2 inches—black fine sandy loam

2 to 13 inches—grayish brown loamy fine sand

13 to 28 inches—dark yellowish brown loam

28 to 60 inches—brown, mottled sandy loam

Typic Ochraqualfs

0 to 3 inches—black silt loam

3 to 15 inches—dark grayish brown silt loam

15 to 29 inches—pale olive, mottled loam

29 to 37 inches—light brownish gray, mottled clay loam

37 to 48 inches—light olive gray silty clay loam

48 to 60 inches—gray, mottled silt loam

Soil Properties and Qualities

Drainage class: Eutroboralfs—well drained; Typic Ochraqualfs—poorly drained or somewhat poorly drained

Permeability: Eutroboralfs—moderate to slow; Typic Ochraqualfs—moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: Eutroboralfs—greater than 6 feet; Typic Ochraqualfs—1 to 3 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- Well drained soils that have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils

Similar soils:

- A few areas of soils that are sandy in the underlying material
- Small areas of soils that have slightly more clay in the subsoil
- Soils that have a sandy subsurface layer

K27—Aquic Eutroboralfs, loamy, nearly level and undulating

Composition

Aquic Eutroboralfs and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Convex to concave foot slopes on moraines, outwash plains, and lake plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 450 acres

Sample Profile

0 to 2 inches—very dark gray fine sandy loam

2 to 4 inches—grayish brown fine sandy loam

4 to 8 inches—yellowish brown loamy fine sand

8 to 16 inches—light yellowish brown, mottled sandy loam

16 to 47 inches—yellowish brown loam

47 to 60 inches—yellowish brown sandy loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Moderately rapid or moderate

Available water capacity: Moderate

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: 2 to 5 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils on convex rises
- The well drained Cutaway soils, which have a sandy mantle; in the higher landscape positions

Similar soils:

- Soils in which the water table is closer to the surface

K28—Aquic Eutroboralfs, silty, nearly level and undulating

Composition

Aquic Eutroboralfs and similar soils: 75 to 85 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Side slopes and summits on lake plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and moderately wide with smooth edges or elongated

Size of areas: 15 to 600 acres

Sample Profile

0 to 4 inches—very dark gray silt loam

4 to 8 inches—grayish brown very fine sandy loam

8 to 16 inches—dark brown, mottled silty clay loam

16 to 35 inches—olive brown, mottled silt loam

35 to 60 inches—light olive brown, mottled silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained

Permeability: Moderate

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow or medium

Depth to the water table: 2 to 4 feet

Inclusions

Contrasting inclusions:

- Poorly drained soils on the lower lying slopes and in depressions
- The moderately well drained Hiwood soils, which are sandy throughout; in landscape positions similar to those of the major soils
- The somewhat poorly drained Stuntz soils, which formed in till; on the lower lying slopes

Similar soils:

- Soils that have a sandy mantle underlain by silty sediments

K30—Typic Ochraqualfs, clayey

Composition

Typic Ochraqualfs and similar soils: 75 to 85 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Toe slopes, depressions, and broad flats on lake plains and moraines

Slope range: 0 to 2 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 600 acres

Sample Profile

4 inches to 0—decomposed forest litter and debris

0 to 12 inches—black silty clay loam

12 to 18 inches—olive gray, mottled silty clay

18 to 26 inches—light olive brown, mottled silty clay loam

26 to 60 inches—olive gray, mottled clay loam

Soil Properties and Qualities

Drainage class: Poorly drained

Permeability: Upper part—moderate; lower part—slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 1 to 3 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in small depressions
- Very poorly drained soils that are sandy throughout

Similar soils:

- A few areas of soils that are sandy in the underlying material
- Soils that have a sandy subsurface layer

K31—Suomi-Aeric Glossaqualfs, loamy, association, nearly level and undulating

Composition

Suomi soil and similar soils: 40 to 50 percent

Aeric Glossaqualfs and similar soils: 25 to 35 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Suomi—plane or slightly convex side slopes on moraines and lake plains; Aeric Glossaqualfs—plane or slightly concave toe slopes, depressions, and drainageways on moraines and lake plains

Slope range: Suomi—0 to 8 percent; Aeric Glossaqualfs—0 to 2 percent

Shape of areas: Moderately long and moderately wide with smooth edges

Size of areas: 15 to 280 acres

Sample Profile

Suomi

0 to 5 inches—dark grayish brown silt loam

5 to 14 inches—dark brown very fine sandy loam

14 to 23 inches—brown very fine sandy loam

23 to 28 inches—dark brown very fine sandy loam and brown clay loam

28 to 34 inches—brown, mottled silty clay loam

34 to 37 inches—yellowish brown, mottled silty clay loam

37 to 60 inches—yellowish brown, mottled clay loam

Aeric Glossaqualfs

- 0 to 5 inches—gray fine sandy loam
- 5 to 9 inches—brown fine sandy loam
- 9 to 13 inches—yellowish brown, mottled fine sandy loam
- 13 to 24 inches—gray, mottled fine sandy loam and dark brown, mottled clay loam
- 24 to 35 inches—dark yellowish brown, mottled clay loam
- 35 to 60 inches—dark brown, mottled silty clay loam

Soil Properties and Qualities

- Drainage class:* Suomi—moderately well drained; Aeric Glossaqualfs—somewhat poorly drained
- Permeability:* Suomi—moderate in the upper part, slow in the lower part; Aeric Glossaqualfs—moderately rapid or moderate in the upper part, moderately slow or slow in the lower part
- Available water capacity:* High
- Organic matter content:* Moderate or moderately low
- Surface runoff:* Suomi—medium; Aeric Glossaqualfs—slow
- Depth to the water table:* Suomi—1 to 2 feet; Aeric Glossaqualfs—1.5 to 3.0 feet

Inclusions

- Contrasting inclusions:*
 - Very poorly drained organic soils in depressions
 - The well drained Warba soils on convex slopes
 - Very poorly drained mineral soils in swales and depressions

K35—Typic Ochraqualfs, ponded**Composition**

- Typic Ochraqualfs and similar soils: 75 to 85 percent
- Contrasting inclusions: 15 to 25 percent

Setting

- Landform and position on the landform:* Depressions, drainageways, and flats on moraines, lake plains, and outwash plains
- Slope range:* 0 to 2 percent
- Shape of areas:* Circular or elongated
- Size of areas:* 5 to 150 acres

Sample Profile

- 0 to 5 inches—black silt loam
- 5 to 10 inches—gray, mottled very fine sandy loam
- 10 to 19 inches—dark gray and gray, mottled gravelly loam
- 19 to 26 inches—olive gray, mottled clay loam
- 26 to 35 inches—olive gray and olive, mottled clay loam
- 35 to 44 inches—olive gray, mottled loam

- 44 to 60 inches—olive gray and light olive gray, mottled loam

Soil Properties and Qualities

- Drainage class:* Very poorly drained
- Permeability:* Moderate or moderately slow
- Available water capacity:* High
- Organic matter content:* Moderate
- Surface runoff:* Very slow or ponded
- Seasonal high water table:* 2 feet above to 2 feet below the surface
- Special characteristics:* Ponded in spring

Inclusions

- Contrasting inclusions:*
 - Very poorly drained organic soils in landscape positions similar to those of the major soils
- Similar soils:*
 - Mineral soils that are better drained

N77—Udipsamments, nearly level and undulating**Composition**

- Udipsamments and similar soils: 85 to 90 percent
- Contrasting inclusions: 10 to 15 percent

Setting

- Landform and position on the landform:* Side slopes and summits on outwash plains
- Slope range:* 0 to 8 percent
- Shape of areas:* Moderately long and moderately wide with curvilinear edges
- Size of areas:* 15 to 450 acres

Sample Profile

- 0 to 1 inch—very dark gray fine sand
- 1 to 4 inches—dark gray fine sand
- 4 to 8 inches—dark yellowish brown fine sand
- 8 to 18 inches—yellowish brown fine sand
- 18 to 60 inches—light yellowish brown fine sand

Soil Properties and Qualities

- Depth:* Very deep
- Drainage class:* Excessively drained
- Permeability:* Rapid
- Available water capacity:* Low
- Organic matter content:* Low
- Surface runoff:* Slow
- Depth to the water table:* Greater than 6 feet

Inclusions

- Contrasting inclusions:*
 - The somewhat poorly drained Redby soils in the lower positions on the landscape

- Very poorly drained mineral soils in drainageways and depressions
- Very poorly drained organic soils in drainageways and depressions

Similar soils:

- Soils that are loamy in the underlying material
- Soils that have thin bands of finer textured material

N78—Psammentic Eutroboralfs, sandy, nearly level and undulating

Composition

Psammentic Eutroboralfs and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and summits on outwash plains

Slope range: 0 to 8 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 450 acres

Sample Profile

2 inches to 0—moderately decomposed forest litter
 0 to 2 inches—very dark grayish brown loamy sand
 2 to 12 inches—brown loamy sand
 12 to 26 inches—dark yellowish brown sand
 26 to 34 inches—dark yellowish brown gravelly loamy coarse sand
 34 to 48 inches—yellowish brown sand
 48 to 58 inches—pale brown coarse sand
 58 to 60 inches—pale brown sand

Soil Properties and Qualities

Drainage class: Well drained and excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow

Depth to the water table: Greater than 6 feet

Inclusions

- The somewhat poorly drained Redby soils in the lower positions on the landscape
- Very poorly drained mineral soils in drainageways and depressions
- Very poorly drained organic soils in drainageways and depressions

Similar soils:

- Soils that are loamy in the underlying material

N79—Psammentic Eutroboralfs, sandy, rolling and hilly

Composition

Psammentic Eutroboralfs and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Side slopes and shoulders on outwash plains

Slope range: 8 to 20 percent

Shape of areas: Moderately long and narrow with curvilinear edges

Size of areas: 15 to 300 acres

Sample Profile

2 inches to 0—moderately decomposed forest litter
 0 to 2 inches—very dark gray loamy sand
 2 to 9 inches—brown loamy sand
 9 to 19 inches—dark yellowish brown sand
 19 to 25 inches—cobble coarse sand
 25 to 31 inches—dark brown loamy coarse sand
 31 to 40 inches—yellowish brown sand
 40 to 60 inches—light yellowish brown sand

Soil Properties and Qualities

Drainage class: Well drained and somewhat excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low

Surface runoff: Slow or medium

Depth to the water table: Greater than 6 feet

Inclusions

- The somewhat poorly drained Redby soils in the lower positions on the landscape
- Very poorly drained mineral soils in drainageways and depressions
- Very poorly drained organic soils in drainageways and depressions

Similar soils:

- Soils that are loamy in the underlying material

N80—Cutaway-Hiwood association, nearly level and undulating

Composition

Cutaway soil and similar soils: 40 to 50 percent

Hiwood soil and similar soils: 25 to 35 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Cutaway—side

slopes and summits; Hiwood—slight rises and shallow drainageways on outwash plains

Slope range: Cutaway—0 to 8 percent; Hiwood—0 to 2 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 10 to 250 acres

Sample Profile

Cutaway

0 to 1 inch—very dark gray loamy sand
 1 to 2 inches—dark gray loamy sand
 2 to 9 inches—brown sand
 9 to 22 inches—light yellowish brown sand
 22 to 27 inches—pale brown sand
 27 to 31 inches—yellowish brown loamy sand and loam
 31 to 42 inches—brown loam
 42 to 48 inches—light olive brown sandy loam
 48 to 60 inches—light yellowish brown, calcareous sandy loam

Hiwood

0 to 2 inches—very dark brown loamy fine sand
 2 to 5 inches—very dark grayish brown loamy fine sand
 5 to 9 inches—dark brown loamy fine sand
 9 to 14 inches—dark yellowish brown loamy fine sand
 14 to 30 inches—yellowish brown, mottled loamy fine sand
 30 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Cutaway—well drained; Hiwood—moderately well drained

Permeability: Cutaway—rapid in the upper part, moderately slow or slow in the lower part; Hiwood—rapid

Available water capacity: Cutaway—moderate; Hiwood—low

Organic matter content: Low or moderately low

Surface runoff: Slow

Depth to the water table: Cutaway—greater than 6 feet; Hiwood—2 to 5 feet

Inclusions

Contrasting inclusions:

- The well drained Warba soils, which are loamy throughout; in landscape positions similar to those of the major soils
- The excessively drained Menahga soils on moraines, which are sandy throughout; in landscape positions similar to those of the major soils
- Very poorly drained mineral and organic soils in depressions and drainageways

Similar soils:

- Soils that have a thinner or thicker sandy mantle

O92—Hiwood-Zimmerman association, nearly level to hilly

Composition

Hiwood soil and similar soils: 40 to 50 percent

Zimmerman soil and similar soils: 35 to 40 percent

Contrasting inclusions: 10 to 25 percent

Setting

Landform and position on the landform: Hiwood—slightly convex swells on outwash plains and lake plains; Zimmerman—plane and slightly convex back slopes, shoulders, and summits on outwash plains and lake plains

Slope range: Hiwood—0 to 3 percent; Zimmerman—0 to 20 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 15 to 450 acres

Sample Profile

Hiwood

1 inch to 0—black forest litter
 0 to 1 inch—very dark grayish brown fine sand
 1 to 4 inches—dark gray fine sand
 4 to 9 inches—dark yellowish brown fine sand
 9 to 16 inches—light yellowish brown fine sand
 16 to 26 inches—yellowish brown fine sand
 26 to 41 inches—pale brown fine sand
 41 to 60 inches—pale brown fine sand and thin bands of brown loamy fine sand

Zimmerman

0 to 2 inches—very dark brown loamy fine sand
 2 to 5 inches—very dark grayish brown loamy fine sand
 5 to 9 inches—dark brown loamy fine sand
 9 to 14 inches—dark yellowish brown loamy fine sand
 14 to 30 inches—yellowish brown, mottled loamy fine sand
 30 to 60 inches—grayish brown, mottled fine sand

Soil Properties and Qualities

Drainage class: Hiwood—moderately well drained; Zimmerman—excessively drained

Permeability: Rapid

Available water capacity: Low

Organic matter content: Low or moderately low

Surface runoff: Hiwood—slow; Zimmerman—slow or medium

Depth to the water table: Hiwood—2 to 5 feet; Zimmerman—greater than 6 feet

Inclusions

Contrasting inclusions:

- Somewhat poorly drained and very poorly drained soils in shallow depressions

- Very poorly drained organic soils in the deeper depressions
 - Soils that are loamy throughout or are underlain by loamy sediments
- Similar soils:*
- Soils that have thin lenses of gravelly or silty material

O93—Eutroboralfs, nearly level and undulating

Composition

Eutroboralfs and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Plane to convex side slopes on moraines
Slope range: 0 to 8 percent
Shape of areas: Long and wide with curvilinear edges
Size of areas: 10 to 250 acres

Sample Profile

0 to 2 inches—black fine sandy loam
2 to 13 inches—grayish brown loamy fine sand
13 to 28 inches—dark yellowish brown loam
28 to 60 inches—brown sandy loam

Soil Properties and Qualities

Drainage class: Well drained
Permeability: Moderate to slow
Available water capacity: High
Organic matter content: Moderately low or moderate
Surface runoff: Slow
Depth to the water table: Greater than 6 feet

Inclusions

- Contrasting inclusions:*
- Very poorly drained organic soils in small depressions
 - The well drained Cutaway soils, which have 20 to 40 inches of sandy material above the loamy subsoil; in landscape positions similar to those of the major soils
 - The somewhat poorly drained Stuntz soils in the lower lying areas or in swales
- Similar soils:*
- Soils that are moderately well drained
 - Soils that have more clay in the subsoil

O94—Redby fine sand

Composition

Redby soil and similar soils: 75 to 85 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Plane to concave foot slopes and toe slopes on outwash plains and lake plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and wide with smooth edges
Size of areas: 15 to 350 acres

Sample Profile

0 to 3 inches—very dark brown fine sand
3 to 5 inches—very dark grayish brown loamy fine sand
5 to 9 inches—dark brown loamy fine sand
9 to 14 inches—brown, mottled loamy fine sand
14 to 27 inches—yellowish brown, mottled loamy fine sand
27 to 60 inches—grayish brown, mottled loamy fine sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Permeability: Rapid
Available water capacity: Low
Organic matter content: Low or moderately low
Surface runoff: Slow
Depth to the water table: 1.5 to 3.0 feet

Inclusions

- Contrasting inclusions:*
- Well drained or excessively drained soils in the more sloping areas
 - Very poorly drained mineral soils in shallow depressions
 - Very poorly drained organic soils in the deeper depressions
- Similar soils:*
- Soils that have thin bands of finer textured material in the subsoil

O95—Humaquepts

Composition

Humaquepts and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Short and moderately wide with curvilinear edges
Size of areas: 5 to 120 acres

Sample Profile

4 inches to 0—dark reddish brown muck

0 to 4 inches—dark gray and gray fine sandy loam
 4 to 10 inches—light brownish gray loamy fine sand
 10 to 29 inches—light olive gray, mottled fine sand
 29 to 60 inches—gray, mottled fine sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained and very poorly drained
Permeability: Rapid to moderate
Available water capacity: Low or moderate
Organic matter content: Moderate or high
Surface runoff: Very slow or slow
Seasonal high water table: At the surface to 2 feet below the surface

Inclusions

Contrasting inclusions:

- Soils that are better drained
- Organic soils near the center of depressions

Similar soils:

- Soils that have thicker organic layers

O96—Mollic Fluvaquents, frequently flooded

Composition

Mollic Fluvaquents and similar soils: 75 to 85 percent
 Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Flood plains
Slope range: 0 to 2 percent
Shape of areas: Moderately wide and long with curvilinear edges
Size of areas: 15 to 800 acres

Sample Profile

0 to 15 inches—black fine sandy loam
 15 to 60 inches—grayish brown, mottled, stratified loamy fine sand, loamy sand, and silt loam

Soil Properties and Qualities

Drainage class: Poorly drained or very poorly drained
Permeability: Rapid to moderately slow
Available water capacity: Moderate
Organic matter content: Moderate or moderately low
Surface runoff: Ponded
Depth to the water table: 2 feet above to 3 feet below the surface
Frequency of flooding: Frequent

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils that are not subject to flooding
- Better drained mineral soils that are not subject to flooding

Similar soils:

- Better drained mineral soils that are subject to occasional flooding

O97—Humaquepts, sandy

Composition

Humaquepts and similar soils: 85 to 90 percent
 Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and drainageways on outwash plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with curvilinear edges
Size of areas: 20 to 300 acres

Sample Profile

4 inches to 0—black muck
 0 to 6 inches—very dark gray fine sand
 6 to 26 inches—gray, mottled fine sand
 26 to 40 inches—light brownish gray, mottled sand
 40 to 60 inches—dark gray, mottled fine sand

Soil Properties and Qualities

Drainage class: Poorly drained and very poorly drained
Permeability: Rapid or moderately rapid
Available water capacity: Moderate or high
Organic matter content: Moderate or high
Surface runoff: Very slow
Seasonal high water table: At the surface to 1 foot below the surface

Inclusions

Contrasting inclusions:

- Areas of very poorly drained organic soils
- Better drained soils in the more sloping areas
- Very poorly drained mineral soils that are loamy throughout
- Areas that are ponded

Similar soils:

- Soils that have a thin organic surface layer
- Soils that have a loamy surface layer

X01—Histosols, depressional

Composition

Histosols and similar soils: 85 to 95 percent
 Contrasting inclusions: 5 to 15 percent

Setting

Landform and position on the landform: Closed

depressions on moraines, lake plains, and outwash plains

Slope range: 0 to 2 percent

Shape of areas: Circular or elongated

Size of areas: 5 to 20 acres

Sample Profile

0 to 15 inches—black muck

15 to 23 inches—very dark gray muck

23 to 49 inches—reddish brown mucky peat

49 to 60 inches—very dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderately slow to rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Slow

Seasonal high water table: 1 foot above to 1 foot below the surface

Inclusions

Contrasting inclusions:

- Better drained mineral soils in sloping areas

Similar soils:

- Very poorly drained mineral soils

X02—Typic Borohemists, acid

Composition

Typic Borohemists and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Broad flats and depressions on moraines, lake plains, and outwash plains

Slope range: 0 to 2 percent

Shape of areas: Long and wide with curvilinear edges

Size of areas: 20 to 2,500 acres

Sample Profile

0 to 60 inches—dark reddish brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Slow

Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:

- Very poorly drained mineral soils on the edges of depressions and drainageways

Similar soils:

- Soils that are less acid and formed in predominantly woody fibers
- Soils that are more decomposed throughout
- Soils that have finer textures in the underlying material

X03—Typic Borohemists, nonacid-Typic Borosaprist association

Composition

Typic Borohemists and similar soils: 40 to 50 percent

Typic Borosaprist and similar soils: 30 to 40 percent

Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Depressions on outwash plains, moraines, and lake plains

Slope range: 0 to 2 percent

Shape of areas: Circular or moderately long and wide with smooth edges

Size of areas: 40 to 1,000 acres

Sample Profile

Typic Borohemists

0 to 11 inches—dark reddish brown mucky peat

11 to 26 inches—very dark grayish brown mucky peat

26 to 50 inches—dark reddish brown mucky peat

50 to 60 inches—dark brown mucky peat

Typic Borosaprist

0 to 20 inches—black muck

20 to 60 inches—dark brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained

Permeability: Borohemists—moderately rapid or moderate; Borosaprist—moderately slow to moderately rapid

Available water capacity: Very high

Organic matter content: Very high

Surface runoff: Slow

Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils that are more acid than the major soils; in raised areas of large bogs
- Very poorly drained mineral soils on the edges of depressions

Similar soils:

- Soils that have sandy or loamy underlying material above a depth of 51 inches
- Soils that are subject to ponding for short periods

X04—Typic Borosaprists-Bowstring association***Composition***

Typic Borosaprists and similar soils: 40 to 50
Bowstring soil and similar soils: 35 to 45 percent
Contrasting inclusions: 15 to 25 percent

Setting

Landform and position on the landform: Flood plains
Slope range: 0 to 2 percent
Shape of areas: Moderately long and narrow with smooth edges
Size of areas: 15 to 800 acres

Sample Profile**Typic Borosaprists**

0 to 20 inches—black muck
20 to 60 inches—dark brown muck

Bowstring

0 to 10 inches—very dark brown muck
10 to 28 inches—dark reddish brown muck
28 to 34 inches—dark reddish brown, rubbed, muck
34 to 41 inches—very dark gray sand
41 to 50 inches—dark reddish brown muck
50 to 60 inches—very dark grayish brown muck

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface
Frequency of flooding: Frequent

Inclusions*Contrasting inclusions:*

- Very poorly drained organic soils that are not subject to flooding

Similar soils:

- Mineral soils that are subject to occasional flooding

X05—Typic Borochemists, nonacid***Composition***

Typic Borochemists and similar soils: 85 to 90 percent

Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and broad basins on moraines, outwash plains, and lake plains

Slope range: 0 to 2 percent

Shape of areas: Moderately long and wide with curvilinear edges

Size of areas: 80 to 600 acres

Sample Profile

0 to 11 inches—dark reddish brown mucky peat
11 to 26 inches—very dark grayish brown mucky peat
26 to 50 inches—dark reddish brown mucky peat
50 to 60 inches—dark brown mucky peat

Soil Properties and Qualities

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Available water capacity: Very high
Organic matter content: Very high
Surface runoff: Slow
Seasonal high water table: 2 feet above to 2 feet below the surface

Inclusions*Contrasting inclusions:*

- Very poorly drained organic soils that are more acid than the major soils; in raised areas of large bogs
- Very poorly drained mineral soils on the edges of depressions and drainageways

XW1—Aqualfs***Composition***

Aqualfs and similar soils: 85 to 90 percent
Contrasting inclusions: 10 to 15 percent

Setting

Landform and position on the landform: Depressions and drainageways on moraines and lake plains

Slope range: 0 to 2 percent

Shape of areas: Moderately long and moderately wide with curvilinear edges

Size of areas: 5 to 120 acres

Sample Profile

1 inch to 0—slightly decomposed forest litter
0 to 2 inches—very dark gray loamy fine sand
2 to 6 inches—light gray loamy fine sand
6 to 12 inches—pale brown, mottled loamy fine sand
12 to 17 inches—dark yellowish brown, mottled fine sandy loam
17 to 31 inches—dark grayish brown, mottled clay loam

31 to 37 inches—brown, mottled clay loam
 37 to 60 inches—light brownish gray, mottled clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained and poorly drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate or moderately slow

Available water capacity: High

Organic matter content: Moderately low or moderate

Surface runoff: Slow

Depth to the water table: 1.0 to 2.5 feet

Inclusions

Contrasting inclusions:

- Very poorly drained organic soils in depressions
- The well drained Warba soils on convex slopes
- Very poorly drained mineral soils in swales and depressions

Similar soils:

- Soils that have layers of silt loam or silty clay loam in the subsoil and underlying material
- A few areas of soils in which the water table is closer to the surface

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture

supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 84,900 acres in the survey area, or nearly 6 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly

grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

In 1987, there were about 680 farms in the county. The average farm size was about 325 acres. In 1990, approximately 66,000 acres was used as cropland. Of the total acreage of cropland, about 7,500 acres was used for corn for grain, 3,000 acres for corn for silage, and 2,400 acres for oats. About 52,000 acres was used for hay. In 1990, there were about 34,700 head of cattle and calves in the county, of which 4,000 were dairy cows. Also, there were about 4,200 hogs (Minnesota Agricultural Statistics Service, 1990).

With proper management, most crops that are adapted to conditions in Minnesota can be grown in Cass County. The main crops are corn for silage, hay, and oats. Small acreages of edible beans, soybeans, sunflowers, wheat, barley, and buckwheat are also grown.

The hazards of wind erosion and water erosion are major concerns in the county. Water erosion is most critical in moderately steep to gently sloping areas on glacial drumlins and moraines, where surface runoff is greater. Conserving the topsoil provides exchange sites for the uptake by plants of nutrients and water. Conservation practices restrict the movement of farm chemicals, nutrients, and sediment resulting from runoff water or from wind erosion, and thus they improve the quality of water for a variety of uses.

Conservation tillage methods, such as no-till or minimum tillage, protect the surface of the soil from the effects of wind erosion and water erosion. Leaving plant residue on the surface helps to prevent crusting, reduces the runoff rate, and increases the rate of water

infiltration. Stripcropping, contour farming, field windbreaks, grassed waterways, and a permanent cover of sod also help to protect the soils from erosion.

The glacial outwash areas are the most susceptible to wind erosion. Field windbreaks and conservation tillage reduce the hazard of wind erosion. Most of the soils in these areas are droughty, and many are suited to irrigation. The coarser textured soils, which have a rapid intake rate and rapid permeability, require larger amounts of irrigation water than other soils. A reliable source of irrigation water is available in most areas. In some places windbreaks have been removed to accommodate irrigation equipment. In areas where windbreaks have been removed, the topsoil should be protected with plant residue during the critical erosion period. Leaving crop residue on the surface also conserves moisture.

Areas of poorly drained soils are best suited to forage crops, such as grass-legume mixtures of reed canarygrass, timothy, alsike clover, or birdsfoot trefoil. Wild meadow hay is harvested in many places. In areas that are adequately drained, organic soils can be used to produce bluegrass seed, sod, or other specialty crops. Also, organic soils can be harvested for horticultural use. Studies have been conducted to determine the feasibility of using peat as an energy source.

Many areas in the county are used for pasture. Pastures can be improved with proper management. General management measures include maintaining proper nutrient levels, using suitable forage crops, using a system of pasture rotation, and maintaining proper stocking rates. Pastures should not be used until the sod is firm, the forage has reached a minimum grazing height, and plants are growing vigorously. Overgrazing reduces the quality of forage and affects the ability of the plants to recover after grazing. Interseeding the pasture with legume-grass combinations, such as clover and reed canarygrass, increases the feed value and the yields of forage. In areas that have cobbles and boulders on the surface, pasture improvement may be difficult.

Most of the soils in Cass County have medium or high levels of available phosphorus and low levels of available potassium. The coarser textured soils generally are deficient in sulfur. Some crops have responded to additional amounts of boron and magnesium on some soils. The uptake of nutrients by the plant is affected by the reaction of the soil (pH). Alfalfa, for example, is sensitive to proper pH levels in the soil. Lime can be applied to increase the pH level. Soil reaction and fertility levels and the kinds and amounts of fertilizer to be applied should be determined by soil tests. Private agricultural businesses, the county

extension office, or the University of Minnesota can provide assistance with soil testing.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and

limitations of groups of soils for woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2*e*. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *R*, *X*, *W*, *T*, *D*, *C*, *S*, *F*, and *L*.

In table 7, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate*

indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil

is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Proper planning, proper tree selection, weed control, pruning, watering, and replanting where necessary are management practices that help to establish and maintain a high-quality windbreak. Snow distribution is affected by the spacing of rows, plant density, and the types of shrubs and trees.

Proper weed control is a significant management concern. Competition from weeds is most severe in areas where the seasonal high water table is within a depth of about 2 feet or where the available water capacity in the upper 40 inches of the soil is more than 3 inches. Weeds can be controlled by using herbicides or by cultivating. The content of organic matter in the surface layer should be considered when herbicides are applied.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

At the end of most of the descriptions under the heading "Detailed Soil Map Units," the soil has been assigned to a windbreak suitability group. These groups

are based primarily on the suitability of the soil for the locally adapted species, as is indicated by their growth and vigor. The windbreak suitability groups in Cass County are described in the following paragraphs. In areas where the hazard of water erosion is severe, site preparation should be limited to spot treatment extending 2 feet from where the plant is established. Detailed interpretations for each windbreak suitability group in the county are provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service. Specific information can also be obtained from the Cass County Soil and Water Conservation District or the Cass County Cooperative Extension Service.

Windbreak suitability group 1.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderately slow to rapid. The soils do not have free carbonates in the upper part of the profile.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2.—This group consists dominantly of poorly drained soils that have a high water table. The soils have been artificially drained and do not have free carbonates in the upper part of the profile.

Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of wetness. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 3.—This group consists dominantly of well drained and moderately well drained, loamy soils. Permeability is moderate, moderately rapid, or moderately slow. The soils do not have free carbonates in the upper part of the profile.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 4F.—This group consists dominantly of well drained, moderately well drained, and somewhat poorly drained soils that have a substratum of dense till. Permeability is slow or very slow.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 5.—This group consists dominantly of well drained soils. The available water capacity is moderate or high.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 6G.—This group consists dominantly of well drained, loamy soils that have sand or sand and gravel at a depth of 20 to 40 inches. The available water capacity is low or moderate.

Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Moisture stress caused by droughtiness can increase the seedling mortality rate. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 7.—This group consists dominantly of well drained to excessively drained soils. The available water capacity is low.

Trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of droughty conditions. Moisture stress caused by droughtiness can result in moderate seedling mortality. Leaving some vegetation on the surface during the early years of establishment helps to control wind erosion. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 10.—The soils in this group are generally not suitable for windbreaks and environmental plantings. Ponding prevents the growth of trees and shrubs. Onsite investigation may identify areas where plantings can be made near the outer edges of these soils. Special treatment may be needed in these areas.

Recreation

Recreational opportunities in Cass County are numerous. The 517 lakes and more than 580,000 acres of county, State, and Federal forest areas provide for a wide variety of recreational activities.

Cross-country skiing and snowmobiling are major winter recreational activities. The county has many miles of groomed and ungroomed cross-country skiing and snowmobile trails. Ice fishing is also a popular winter sport.

The lakes in the county attract a sizable summer population to the many resorts, seasonal homes, and public campgrounds. Many seasonal residences have become year-round homes as more retirees become permanent residents of the county.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered.

Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding

should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are brome grass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wildrye, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, chokecherry, apple, hawthorn, dogwood, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild rice, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow

water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include sharptail grouse, Hungarian partridge, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey,

determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves,

utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields,

sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes

up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick

enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of

more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large

amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is

needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

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Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 5). "Loam," for example, is soil that is 7

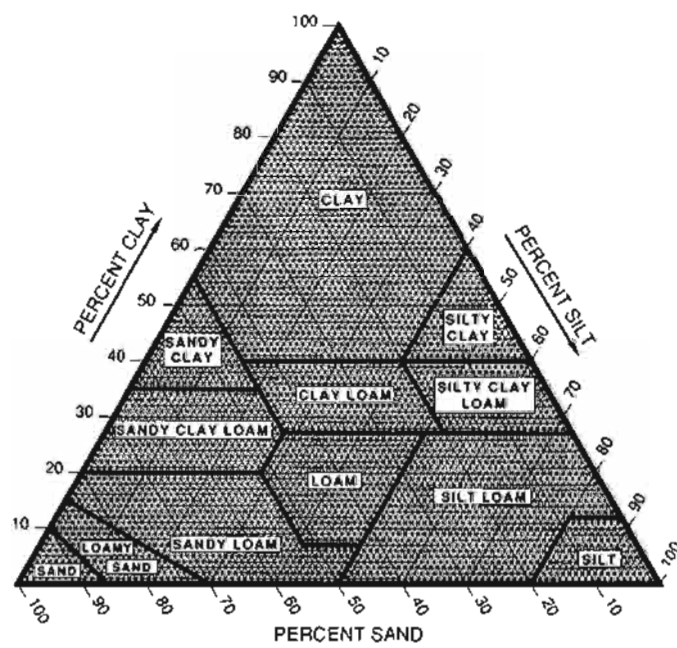


Figure 5.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations

and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops

and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist

mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the

extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected total subsidence, which usually results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or

weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that

are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

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Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Epiaqualfs (*Epi*, meaning perched water table, plus *aqualf*, the suborder of the Alfisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Mollic Epiaqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and

other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, mixed, frigid Mollic Epiaqualfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, matrix colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alstad Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed Glossaquic
Eutroboralfs

Typical Pedon

Alstad fine sandy loam, 2,050 feet west and 2,500 feet north of the southeast corner of sec. 6, T. 134 N., R. 29 W.

A—0 to 5 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; moderate very fine granular structure; very friable; many very fine roots; about 1 percent gravel; moderately acid; abrupt smooth boundary.

E—5 to 15 inches; brown (10YR 5/3) fine sandy loam; common medium distinct dark gray (10YR 4/1) and few fine distinct yellowish brown (10YR 5/6) mottles; moderate thick platy structure parting to moderate fine subangular blocky; friable; common fine roots; about 1 percent gravel; strongly acid; clear wavy boundary.

B/E—15 to 20 inches; about 60 percent dark brown (7.5YR 4/4) sandy loam (Bt) and 40 percent brown (10YR 5/3) sandy loam (E); few medium prominent gray (10YR 5/1) mottles; moderate medium subangular blocky structure parting to weak fine subangular blocky; friable; few fine roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bt1—20 to 24 inches; strong brown (7.5YR 5/6) sandy loam; common medium prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; friable; few fine roots; few distinct brown (7.5YR 5/2) clay films on faces of peds; about 3 percent gravel; strongly acid; clear smooth boundary.

Bt2—24 to 31 inches; strong brown (7.5YR 5/6) sandy loam; common coarse prominent light brownish gray (10YR 6/2) and common fine prominent pale brown (10YR 6/3) mottles; moderate coarse subangular blocky structure; friable; few fine roots; few distinct dark yellowish brown (10YR 4/6) clay films on faces of peds; about 3 percent gravel; strongly acid; clear smooth boundary.

BC—31 to 38 inches; brown (7.5YR 5/4) sandy loam; many coarse prominent light gray (10YR 6/1) and common medium prominent strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; firm; few fine roots; about 3 percent gravel; moderately acid; gradual smooth boundary.

C—38 to 60 inches; brown (10YR 5/3) sandy loam; common medium faint light brownish gray (10YR 6/2) and many fine prominent strong brown (7.5YR

5/6) mottles; massive; firm; about 3 percent gravel; moderately acid.

Range in Characteristics

Content of rock fragments: 1 to 15 percent

Other features: An E/B horizon in some pedons

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 or 3

Texture—fine sandy loam, silt loam, loam, or sandy loam

B/E horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam, loam, or clay loam

BC horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam, loam, or clay loam

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam, loam, or clay loam

Baudette Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Lake plains

Parent material: Silty lacustrine sediments

Slope range: 1 to 6 percent

Taxonomic class: Fine-silty, mixed Aquic Eutroboralfs

Typical Pedon

Baudette silt loam, 1 to 6 percent slopes, 250 feet north and 570 feet east of the southwest corner of sec. 17, T. 143 N., R. 27 W.

A—0 to 3 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular

structure; very friable; moderately acid; abrupt smooth boundary.

E—3 to 10 inches; pale brown (10YR 6/3) silt loam; few medium distinct brownish yellow (10YR 6/6) mottles; moderate medium platy structure; friable; moderately acid; clear smooth boundary.

Bt1—10 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; common distinct light gray (10YR 7/2) silt coatings on faces of peds; few faint brown (10YR 5/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—13 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; friable; common faint dark brown (10YR 3/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—17 to 21 inches; brown (10YR 5/3) silty clay loam; few fine faint light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; friable; few faint dark brown (10YR 4/3) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt4—21 to 26 inches; brown (10YR 5/3) silty clay loam; few fine prominent strong brown (7.5YR 5/8) mottles; moderate fine subangular blocky structure; friable; few faint dark brown (10YR 4/3) clay films on faces of peds; slightly acid; clear smooth boundary.

BC—26 to 32 inches; dark grayish brown (2.5Y 5/2) silt loam; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

C—32 to 60 inches; light olive brown (2.5Y 5/4) silt loam; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 36 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 to 3

Texture—fine sandy loam or silt loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—silt loam, loam, silty clay loam, or clay loam

BC horizon:

Colors—similar to those of the C horizon

Textures—similar to those of the C horizon

C horizon:

Hue—2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—silt loam, very fine sandy loam, loam, or loamy very fine sand

Bergkeller Series

Depth class: Very deep

Drainage class: Well drained and moderately well drained

Permeability: Upper part—moderate; lower part—rapid

Landform: Moraines

Parent material: Till and the underlying sand and gravel

Slope range: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Bergkeller sandy loam, 1 to 6 percent slopes, 2,640 feet north and 325 feet east of the southwest corner of sec. 27, T. 138 N., R. 32 W.

Oi—1 inch to 0; forest litter derived from pine needles, leaves, twigs, and roots.

A—0 to 3 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; very strongly acid; abrupt smooth boundary.

Bw1—3 to 10 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; about 5 percent gravel; strongly acid; clear smooth boundary.

Bw2—10 to 21 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; about 5 percent gravel; strongly acid; abrupt smooth boundary.

2Bt—21 to 32 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few distinct dark brown (7.5YR 4/4) clay films on faces of peds; about 10 percent gravel; strongly acid; abrupt smooth boundary.

3BC—32 to 40 inches; strong brown (7.5YR 4/6) sand; single grain; loose; about 6 percent gravel and 5 percent cobbles; strongly acid; clear smooth boundary.

3C—40 to 60 inches; yellowish brown (10YR 5/6) gravelly coarse sand; single grain; loose; about 15

percent gravel and 5 percent cobbles; moderately acid.

Range in Characteristics

Special features: An E horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

Texture—loamy sand or sandy loam

Content of rock fragments—0 to 10 percent

2Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—4 to 6

Texture—sandy loam, coarse sandy loam, or the gravelly analogs of these textures

Content of rock fragments—10 to 30 percent

3BC horizon:

Colors—similar to those of the 3C horizon

Textures—similar to those of the 3C horizon

3C horizon:

Hue—10YR or 7.5YR

Value—5 or 6

Chroma—4 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—10 to 30 percent

Blowers Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—very slow

Landform: Drumlins

Parent material: Dense till

Slope range: 1 to 5 percent

Taxonomic class: Coarse-loamy, mixed Glossaquic Eutroboralfs

Typical Pedon

Blowers sandy loam, acid substratum, 1 to 5 percent slopes, 100 feet south and 1,700 feet east of the northwest corner of sec. 9, T. 133 N., R. 31 W.

Ap—0 to 5 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; moderate fine granular

structure; friable; about 3 percent gravel; strongly acid; abrupt smooth boundary.

E—5 to 10 inches; brown (10YR 5/3) sandy loam, light brownish gray (10YR 6/2) dry; moderate fine subangular blocky structure; friable; about 3 percent gravel; moderately acid; clear smooth boundary.

E/B—10 to 17 inches; about 60 percent brown (10YR 5/3) sandy loam (E) and 40 percent yellowish brown (10YR 5/6) sandy loam (Bt); moderate coarse subangular blocky structure parting to weak fine subangular blocky; friable; about 3 percent gravel; moderately acid; gradual wavy boundary.

B/E—17 to 23 inches; about 60 percent yellowish brown (10YR 4/4) sandy loam (Bt) and 40 percent brown (10YR 5/3) sandy loam (E); common medium distinct light brownish gray (10YR 6/2) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate very fine, fine, and medium subangular blocky structure parting to moderate very fine subangular blocky; friable; about 7 percent gravel; strongly acid; clear smooth boundary.

Bt—23 to 35 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate very fine, fine, and medium subangular blocky structure parting to moderate very fine subangular blocky; few faint brown (10YR 4/3) clay films on faces of ped; firm; few black (10YR 2/1) concentrations of manganese in ped interiors; about 10 percent gravel; strongly acid; clear smooth boundary.

BC—35 to 44 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate very fine, fine, and medium subangular blocky structure parting to moderate very fine subangular blocky; firm; about 10 percent gravel; moderately acid; clear smooth boundary.

Cd—44 to 60 inches; yellowish brown (10YR 5/4) sandy loam; many coarse prominent light brownish gray (2.5Y 6/2) and common fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; about 10 percent gravel; moderately acid.

Range in Characteristics

Content of rock fragments: 2 to 15 percent

Depth to carbonates: 40 to more than 60 inches

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 or 3

Texture—sandy loam or loamy sand

E/B or B/E horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 5

Texture—sandy loam

BC horizon (if it occurs):

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 5

Texture—sandy loam

Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 to 5

Texture—sandy loam

Bowstring Series*Depth class:* Very deep*Drainage class:* Very poorly drained*Permeability:* Moderately rapid to moderately slow*Landform:* Flood plains*Parent material:* Highly decomposed organic material*Slope range:* 0 to 1 percent*Taxonomic class:* Euic Fluvaquentic Borosaprists**Typical Pedon**

Bowstring muck, in an area of Bowstring-Seelyeville complex, frequently flooded, 1,900 feet north and 1,450 feet west of the southeast corner of sec. 25, T. 141 N., R. 27 W.

Oa1—0 to 6 inches; muck, very dark brown (10YR 2/2) broken face and rubbed; about 10 percent fiber, 5 percent rubbed; massive; herbaceous fiber; about 5 percent mineral material; slightly alkaline; clear smooth boundary.

Oa2—6 to 25 inches; muck, dark reddish brown (5YR 2/2) broken face and rubbed; about 25 percent fiber, 5 percent rubbed; massive; herbaceous fiber; about 5 percent mineral material; slightly alkaline; clear smooth boundary.

Oa3—25 to 32 inches; muck, dark reddish brown (5YR 2/2) broken face, dark reddish brown (5YR 2/3) rubbed; about 25 percent fiber, 3 percent rubbed; many thin strata of fine sand causing parting to

thick platy structure; herbaceous fiber; about 20 percent mineral material; slightly alkaline; clear smooth boundary.

Cg—32 to 40 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) sand; loose; slightly alkaline; abrupt smooth boundary.

O'a1—40 to 52 inches; muck, dark reddish brown (5YR 2/2) broken face and rubbed; about 30 percent fiber, 10 percent rubbed; massive; woody fiber; about 5 percent mineral material; about 5 percent woody coarse fragments; slightly alkaline; gradual smooth boundary.

O'a2—52 to 68 inches; muck, very dark grayish brown (10YR 3/2) broken face, very dark gray (10YR 3/1) rubbed; about 10 percent fiber, 5 percent rubbed; massive; woody fiber; about 35 percent mineral material; slightly alkaline.

Range in Characteristics*Oa horizon:*

Hue—5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Thickness—24 to 48 inches

Kind of material—sapric

Depth to mineral material—24 to 48 inches

Content of fibers—10 to 25 percent unrubbed; 0 to 10 percent rubbed

Content of wood fragments greater than 2 millimeters in size—0 to 10 percent

Cg horizon:

Thickness—2 to 12 inches

Hue—10YR to 5Y

Value—3 to 6

Chroma—1 or 2

Texture—sand, fine sand, loamy sand, or loam

Bushville Series*Depth class:* Very deep*Drainage class:* Moderately well drained*Permeability:* Upper part—rapid; lower part—very slow*Landform:* Drumlins and moraines*Parent material:* Sandy mantle and the underlying dense till*Slope range:* 1 to 3 percent*Taxonomic class:* Loamy, mixed Aquic Arenic Eutroboralfs**Typical Pedon**

Bushville loamy sand, 1 to 3 percent slopes, 400 feet west and 2,100 feet south of the northeast corner of sec. 14, T. 139 N., R. 25 W.

A1—0 to 1 inch; black (10YR 2/1) loamy sand, dark

grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

A2—1 to 5 inches; brown (10YR 3/3) loamy sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

E—5 to 27 inches; yellowish brown (10YR 5/4) loamy sand; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; common fine roots; slightly acid; clear wavy boundary.

2Bt—27 to 38 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct strong brown (7.5YR 5/6) and common fine distinct brown (7.5YR 5/2) mottles; weak thick platy structure parting to weak medium subangular blocky; friable; common medium roots; few distinct reddish brown (5YR 4/3) clay films on faces of peds; about 8 percent gravel; moderately acid; clear wavy boundary.

2BC—38 to 48 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct strong brown (7.5YR 5/6) and common fine distinct brown (7.5YR 5/2) mottles in the upper part; moderate thick platy structure; firm; few medium roots; few distinct dark reddish brown (5YR 3/3) clay films on faces of peds and in pores; about 10 percent gravel; slightly acid; gradual wavy boundary.

2Cd—48 to 60 inches; dark brown (7.5YR 4/4) sandy loam; massive; thick platy soil fragments; very firm; about 10 percent gravel; neutral.

Range in Characteristics

Special features: An E horizon in some pedons

A or Ap horizon:

Hue—10YR
Value—2 to 4
Chroma—1 to 3
Texture—loamy sand
Content of rock fragments—0 to 2 percent gravel

E horizon (if it occurs):

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—2 or 3
Texture—sand, loamy fine sand, or fine sand
Content of rock fragments—0 to 2 percent gravel

2Bt horizon:

Hue—7.5YR or 5YR
Value—4 or 5
Chroma—3 or 4
Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures
Content of rock fragments—2 to 20 percent gravel

2BC horizon (if it occurs):

Colors—similar to those of the 2Cd horizon
Textures—similar to those of the 2Cd horizon

2Cd horizon:

Hue—7.5YR or 5YR
Value—3 to 5
Chroma—3 to 6
Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures
Content of rock fragments—2 to 20 percent gravel

Cathro Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderately slow to moderately rapid; lower part—moderate or moderately slow

Landform: Moraines and till-floored lake plains

Parent material: Highly decomposed organic material underlain by loamy mineral material

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Cathro muck, 900 feet north of the southeast corner of sec. 13, T. 139 N., R. 28 W.

Oa1—0 to 15 inches; muck, very dark brown (10YR 2/2) broken face, rubbed, and pressed; about 30 percent fiber, 10 percent rubbed; weak very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

Oa2—15 to 40 inches; muck, black (5YR 2.5/1) broken face and black (N 2/0) rubbed and pressed; about 20 percent fiber, 5 percent rubbed; massive; friable; strongly acid; abrupt smooth boundary.

C—40 to 60 inches; light brownish gray (10YR 6/2) loam; massive; friable; neutral.

Range in Characteristics

Special features: An Ab horizon in some pedons

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral
Value—2 or 3
Chroma—0 to 2
Thickness—16 to 50 inches
Kind of material—sapric
Content of fibers—20 to 50 percent unrubbed; 0 to 10 percent rubbed

Ab horizon (if it occurs):

Hue—10YR
Value—2 or 3

Chroma—1

Texture—mucky loam

Cg horizon:

Hue—2.5Y or 5BG

Value—4 to 6

Chroma—1 or 2

Texture—loam, clay loam, sandy loam, sandy clay loam, silt loam, or silty clay loam

Cromwell Series

Depth class: Very deep

Drainage class: Somewhat excessively drained and moderately well drained

Permeability: Upper part—moderate; lower part—rapid

Landform: Outwash plains and moraines

Parent material: Thin loamy mantle and the underlying sand

Slope range: 0 to 25 percent

Taxonomic class: Sandy, mixed, frigid Typic Dystrochrepts

Typical Pedon

Cromwell sandy loam, 1 to 8 percent slopes, 20 feet north and 1,600 feet west of the southeast corner of sec. 34, T. 140 N., R. 26 W.

A—0 to 4 inches; very dark gray (10YR 3/1) sandy loam, gray (10YR 5/1) dry; weak medium granular structure; very friable; many very fine roots; strongly acid; abrupt wavy boundary.

Bw1—4 to 17 inches; dark brown (10YR 4/3) sandy loam; moderate fine subangular blocky structure; friable; common very fine roots; strongly acid; clear wavy boundary.

2Bw2—17 to 25 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; few very fine roots; about 2 percent gravel; strongly acid; clear wavy boundary.

2BC—25 to 35 inches; yellowish brown (10YR 5/4) coarse sand; single grain; loose; about 2 percent gravel; moderately acid; clear wavy boundary.

2C1—35 to 47 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 12 percent gravel; moderately acid; gradual wavy boundary.

2C2—47 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 8 percent gravel; moderately acid.

Range in Characteristics

Special features: An E horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—sandy loam

Content of rock fragments—0 to 15 percent

Bw horizon:

Hue—10YR

Value—3 to 6

Chroma—3 or 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—0 to 15 percent

2Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 6

Chroma—4

Texture—loamy sand, sand, or coarse sand

Content of rock fragments—0 to 15 percent

2BC horizon (if it occurs):

Hue—7.5YR or 10YR

Value—5 or 6

Chroma—3 or 4

Texture—coarse sand or sand

Content of rock fragments—0 to 15 percent

2C horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—3 or 4

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent

Cushing Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Cushing loam, 8 to 15 percent slopes, 2,000 feet east and 1,810 feet north of the southwest corner of sec. 22, T. 134 N., R. 30 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

E—5 to 17 inches; brown (10YR 5/3) sandy loam; moderate medium platy structure parting to weak very fine subangular blocky; friable; many very fine

roots; about 3 percent gravel; strongly acid; abrupt wavy boundary.

B/E—17 to 25 inches; about 60 percent dark brown (7.5YR 4/4) loam (Bt) and 40 percent brown (10YR 5/3) sandy loam (E); strong medium subangular blocky structure; firm; common very fine roots; few faint dark brown (10YR 4/3) clay films on faces of peds (Bt); about 3 percent gravel; strongly acid; clear wavy boundary.

Bt1—25 to 37 inches; dark brown (7.5YR 4/4) clay loam; strong medium angular blocky structure; firm; common very fine roots; common faint dark brown (10YR 4/3) clay films on faces of peds; about 3 percent gravel; strongly acid; clear wavy boundary.

Bt2—37 to 49 inches; brown (7.5YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common fine roots; few faint brown (10YR 5/3) clay films on faces of peds; about 3 percent gravel; moderately acid; clear wavy boundary.

C—49 to 60 inches; dark brown (7.5YR 4/4) sandy clay loam; massive; firm; about 4 percent gravel; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

Other features: An E/B horizon in some pedons; a BC horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loam or fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

Texture—loamy sand, sandy loam, loam, silt loam, fine sandy loam, or very fine sandy loam

B/E horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—clay loam, sandy clay loam, fine sandy loam, loam, or sandy loam

C horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy clay loam, fine sandy loam, loam, or sandy loam

Cutaway Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow or slow

Landform: Moraines

Parent material: Sandy mantle and the underlying till or lacustrine sediments

Slope range: 1 to 25 percent

Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Cutaway loamy sand, 1 to 10 percent slopes, 1,600 feet north and 2,400 feet west of the southeast corner of sec. 12, T. 143 N., R. 31 W.

A—0 to 1 inch; very dark gray (10YR 3/1) loamy sand; weak fine granular structure; very friable; many fine roots; very strongly acid; abrupt smooth boundary.

E—1 to 2 inches; dark gray (10YR 4/1) loamy sand; weak very fine subangular blocky structure; very friable; many fine roots; very strongly acid; clear smooth boundary.

Bw1—2 to 9 inches; brown (10YR 5/3) sand; single grain; loose; many fine roots; very strongly acid; clear smooth boundary.

Bw2—9 to 22 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; common fine roots; strongly acid; clear smooth boundary.

Bw3—22 to 27 inches; pale brown (10YR 6/3) sand; single grain; loose; few fine roots; about 2 percent gravel; moderately acid; clear smooth boundary.

2E/B—27 to 31 inches; about 70 percent yellowish brown (10YR 5/4) loamy sand (E') and 30 percent yellowish brown (10YR 5/4) loam (Bt); moderate medium subangular blocky structure; friable; few fine roots; few faint dark brown (10YR 4/3) clay films on faces of peds (Bt); about 3 percent gravel; moderately acid; clear wavy boundary.

2Bt—31 to 37 inches; brown (10YR 5/3) loam; moderate medium subangular blocky structure; firm; few fine roots; few faint dark yellowish brown (10YR 4/4) clay films on faces of peds; about 3 percent gravel; slightly acid; clear smooth boundary.

2BC—37 to 42 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; firm; few fine roots; about 3 percent gravel; slight effervescence; neutral; clear smooth boundary.

2C1—42 to 48 inches; light olive brown (2.5Y 5/4) sandy loam; massive; friable; about 3 percent gravel; strong effervescence; slightly alkaline; gradual smooth boundary.

2C2—48 to 60 inches; light yellowish brown (2.5Y 6/4)

sandy loam; massive; friable; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 36 to 52 inches

Other features: An E' horizon in some pedons; an EB or BE horizon in some pedons; a B/E horizon in some pedons

A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand

Content of rock fragments—0 to 10 percent

E horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—1 or 2

Texture—loamy sand or loamy fine sand

Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—3 or 4

Texture—loamy sand, loamy fine sand, or sand

Content of rock fragments—0 to 10 percent

2E/B horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

2Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—loam, clay loam, sandy clay loam, sandy loam, fine sandy loam, or silt loam

Content of rock fragments—2 to 10 percent

2BC horizon (if it occurs):

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 or 4

Texture—loam, clay loam, sandy clay loam, sandy loam, fine sandy loam, or silt loam

Content of rock fragments—2 to 10 percent

2C horizon:

Hue—2.5Y or 10YR

Value—4 to 7

Chroma—2 to 4

Texture—loam, clay loam, sandy clay loam, sandy loam, fine sandy loam, or silt loam

Content of rock fragments—2 to 10 percent

Demontreville Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow

Landform: Moraines

Parent material: Sandy mantle and the underlying till

Slope range: 2 to 40 percent

Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Demontreville loamy sand, 2 to 8 percent slopes, 2,640 feet north and 1,400 feet east of the southwest corner of sec. 13, T. 139 N., R. 31 W.

A—0 to 4 inches; brown (10YR 5/3) loamy sand, pale brown (10YR 6/3) dry; weak medium platy structure parting to weak very fine subangular blocky; very friable; many coarse roots; about 7 percent gravel; strongly acid; clear wavy boundary.

Bw1—4 to 10 inches; dark yellowish brown (10YR 4/4) loamy sand; weak very fine and fine subangular blocky structure; friable; many medium roots; about 10 percent gravel; strongly acid; clear smooth boundary.

Bw2—10 to 25 inches; yellowish brown (10YR 5/4) loamy sand; moderate fine subangular blocky structure; friable; many medium roots; about 10 percent gravel; strongly acid; clear wavy boundary.

2B/E—25 to 33 inches; about 60 percent strong brown (7.5YR 4/6) sandy loam (Bt) and 40 percent yellowish brown (10YR 5/4) loamy sand (E); moderate medium subangular blocky structure; friable (E); firm (Bt); many fine roots; about 10 percent gravel; moderately acid; clear wavy boundary.

2Bt—33 to 47 inches; strong brown (7.5YR 4/6) sandy loam; moderate medium subangular blocky structure; firm; few fine roots; common prominent dark yellowish brown (10YR 4/4) clay films on faces of peds; about 9 percent gravel; moderately acid; clear wavy boundary.

2C1—47 to 57 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; about 10 percent gravel; moderately acid; clear smooth boundary.

2C2—57 to 60 inches; dark brown (7.5YR 4/4) sandy loam; weak very fine subangular blocky structure; firm; about 9 percent gravel; slightly acid.

Range in Characteristics

Special features: An E/B horizon in some pedons

A horizon:

Hue—10YR

Value—2 to 5
 Chroma—1 to 3
 Texture—loamy sand
 Content of rock fragments—0 to 10 percent

E horizon (if it occurs):

Hue—10YR or 7.5YR
 Value—3 to 5
 Chroma—2 to 4
 Texture—loamy sand, sand, loamy fine sand, or fine sand
 Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—4 to 6
 Texture—loamy sand, loamy coarse sand, coarse sand, sand, fine sand, or loamy fine sand
 Content of rock fragments—0 to 10 percent

2B/E horizon (if it occurs):

Colors—similar to those of the E and 2Bt horizons
 Textures—similar to those of the E and 2Bt horizons

2Bt horizon:

Hue—7.5YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—sandy loam, sandy clay loam, loam, fine sandy loam, or the gravelly analogs of these textures
 Content of rock fragments—8 to 20 percent

2C horizon:

Hue—7.5YR
 Value—3 or 4
 Chroma—4 to 6
 Texture—sandy loam, coarse sandy loam, or the gravelly analogs of these textures
 Content of rock fragments—8 to 20 percent

Flak Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—very slow

Landform: Moraines and drumlins

Parent material: Dense till

Slope range: 3 to 15 percent

Taxonomic class: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Flak sandy loam, 8 to 15 percent slopes, 2,640 feet west and 2,640 feet north of the southeast corner

of sec. 10, T. 135 N., R. 30 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; many fine roots; about 4 percent gravel; strongly acid; abrupt smooth boundary.

E—6 to 14 inches; brown (10YR 5/3) sandy loam; weak fine subangular blocky structure; friable; many fine roots; about 3 percent gravel; strongly acid; clear wavy boundary.

Bt—14 to 26 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; common faint dark yellowish brown (10YR 4/4) clay films on faces of peds; about 5 percent gravel; moderately acid; gradual wavy boundary.

BC—26 to 41 inches; brown (7.5YR 4/4) sandy loam; weak medium platy structure; firm; few very fine roots; about 10 percent gravel; moderately acid; gradual wavy boundary.

Cd—41 to 60 inches; brown (7.5YR 4/4) sandy loam; massive; moderate medium platy fragments; very firm; about 10 percent gravel; moderately acid.

Range in Characteristics

A or Ap horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—sandy loam
 Content of rock fragments—2 to 15 percent

E horizon:

Hue—10YR
 Value—4 or 5
 Chroma—2 or 3
 Texture—fine sandy loam, sandy loam, or loamy sand
 Content of rock fragments—2 to 15 percent

Bt horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy loam or fine sandy loam
 Content of rock fragments—2 to 15 percent

BC horizon:

Colors—similar to those of the Cd horizon
 Textures—similar to those of the Cd horizon

Cd horizon:

Hue—7.5YR or 10YR
 Value—4 or 5
 Chroma—3 to 5
 Texture—sandy loam, loamy sand, or the gravelly analogs of these textures

Content of rock fragments—2 to 20 percent

Friendship Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—rapid, moderate, or moderately slow

Landform: Outwash plains, moraines, and drumlins

Parent material: Sandy sediments

Slope range: 0 to 6 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Friendship loamy sand, 50 feet south and 1,600 feet east of the northwest corner of sec. 9, T. 138 N., R. 32 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; very friable; many fine roots; moderately acid; abrupt smooth boundary.

Bw1—4 to 9 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine roots; moderately acid; clear smooth boundary.

Bw2—9 to 28 inches; yellowish brown (10YR 5/6) sand; single grain; loose; few fine roots; slightly acid; clear smooth boundary.

BC—28 to 37 inches; yellowish brown (10YR 5/4) sand; common medium prominent strong brown (7.5YR 5/6) mottles; single grain; loose; strongly acid; clear smooth boundary.

C1—37 to 43 inches; strong brown (7.5YR 4/6) sand; common medium distinct yellowish red (5YR 4/6), common medium distinct yellowish red (5YR 5/6), and few fine prominent brown (10YR 5/3) mottles; single grain; loose; strongly acid; clear smooth boundary.

C2—43 to 60 inches; pale brown (10YR 6/3) sand; many coarse prominent yellowish red (5YR 4/6) and common medium prominent strong brown (7.5YR 4/6) mottles; single grain; loose; strongly acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

Other features: An E horizon in some pedons; a 2C horizon below a depth of 40 inches in some pedons

Ap or A horizon:

Hue—7.5YR or 10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Bw horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 to 6

Texture—loamy sand or sand

BC horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—sand

2C horizon (if it occurs):

Texture—sandy loam, fine sandy loam, loam, or clay loam

Goodland Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—rapid

Landform: Moraines

Parent material: Silty mantle over loamy sediments and the underlying sandy material

Slope range: 1 to 15 percent

Taxonomic class: Coarse-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Goodland silt loam, in an area of Itasca-Goodland complex, 1 to 8 percent slopes, 2,560 feet east and 500 feet north of the southwest corner of sec. 13, T. 140 N., R. 25 W.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) silt loam, light gray (10YR 6/1) dry; weak medium granular structure; very friable; many very fine and fine roots; moderately acid; abrupt wavy boundary.

E—1 to 4 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; very friable; many fine and medium roots; moderately acid; clear wavy boundary.

Bw—4 to 10 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; many fine roots; moderately acid; clear wavy boundary.

E'—10 to 13 inches; brown (10YR 5/3) silt loam; weak very thin platy structure; friable; few fine roots; moderately acid; clear smooth boundary.

E/B—13 to 18 inches; about 60 percent brown (10YR

- 5/3) very fine sandy loam (E) and 40 percent dark brown (7.5YR 4/4) sandy loam (Bt); moderate medium subangular blocky structure; friable; few fine roots; moderately acid; clear wavy boundary.
- 2Bt—18 to 27 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; firm; few fine roots; common distinct dark brown (7.5YR 3/4) clay films on faces of peds; about 3 percent gravel; moderately acid; clear smooth boundary.
- 3BC—27 to 35 inches; brown (7.5YR 5/4) loamy coarse sand; weak very fine subangular blocky structure; very friable; about 10 percent gravel; moderately acid; gradual smooth boundary.
- 3C—35 to 60 inches; dark brown (10YR 4/3) coarse sand; single grain; loose; about 12 percent gravel; neutral.

Range in Characteristics

A or Ap horizon (if it occurs):

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam
Content of rock fragments—0 to 2 percent

E horizon:

Hue—10YR or 2.5Y
Value—4 to 6
Chroma—1 to 3
Texture—very fine sandy loam or silt loam
Content of rock fragments—0 to 2 percent

Bw horizon:

Hue—10YR or 7.5YR
Value—4 to 6
Chroma—3 to 6
Texture—silt loam, very fine sandy loam, or loam
Content of rock fragments—0 to 2 percent

E' horizon:

Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 or 3
Texture—silt loam, very fine sandy loam, or loam
Content of rock fragments—0 to 2 percent

E/B or B/E horizon:

Colors—similar to those of the E' and Bt horizons
Textures—similar to those of the E' and Bt horizons

2Bt horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—fine sandy loam, sandy loam, or loam
Content of rock fragments—3 to 10 percent

3BC horizon:

Hue—10YR or 7.5YR
Value—4 or 5
Chroma—3 or 4
Texture—loamy coarse sand, gravelly loamy coarse sand, loamy sand, or gravelly sandy loam
Content of rock fragments—0 to 25 percent

3C horizon:

Hue—10YR or 7.5YR
Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, gravelly sand, or gravelly coarse sand
Content of rock fragments—0 to 25 percent

Graycalm Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Rapid

Landform: Outwash plains and moraines

Parent material: Sandy outwash

Slope range: 1 to 15 percent

Taxonomic class: Mixed, frigid Argic Udipsamments

Typical Pedon

Graycalm loamy sand, 1 to 8 percent slopes, 300 feet south and 750 feet east of the northwest corner of sec. 32, T. 140 N., R. 27 W.

A—0 to 3 inches; dark brown (10YR 4/3) loamy sand, brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable; strongly acid; abrupt smooth boundary.

Bw—3 to 8 inches; dark brown (7.5YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; strongly acid; abrupt smooth boundary.

E—8 to 16 inches; light yellowish brown (10YR 6/4) sand; single grain; loose, very friable; strongly acid; clear smooth boundary.

E&Bt—16 to 52 inches; light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), and yellowish brown (10YR 5/6) sand (E) and dark brown (7.5YR 4/4) loamy sand (Bt); weak fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

C—52 to 60 inches; brownish yellow (10YR 6/6) sand; single grain; loose; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

A horizon:

Hue—10YR
Value—2 to 4

Chroma—1 or 2
Texture—loamy sand

E horizon:

Hue—10YR
Value—6 or 7
Chroma—1 to 4
Texture—sand, loamy sand, or loamy coarse sand

Bw horizon:

Hue—7.5YR or 10YR
Value—4 or 5
Chroma—4 or 5
Texture—sand or loamy sand

E&Bt horizon:

Colors—similar to those of the E and Bt horizons
Textures—similar to those of the E and Bt horizons

Bt horizon:

Thickness— $\frac{1}{16}$ inch to 2 inches; within a depth of 60 inches, cumulative thickness of less than 6 inches
Hue—7.5YR
Value—3 to 6
Chroma—4 to 6
Texture—loamy sand, sandy loam, or fine sandy loam

C horizon:

Hue—10YR
Value—5 to 7
Chroma—3 to 6
Texture—sand

Greenwood Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid

Landform: Moraines, outwash plains, and till-floored glacial lake plains

Parent material: Herbaceous organic material

Slope range: 0 to 1 percent

Taxonomic class: Dysic Typic Borohemists

Typical Pedon

Greenwood peat, 2,700 feet east and 2,700 feet north of the southwest corner of sec. 10, T. 144 N., R. 28 W.

Oi—0 to 8 inches; peat, light gray (10YR 6/1) broken face and light gray (10YR 7/2) rubbed and pressed; about 90 percent fiber, 70 percent rubbed; massive; friable; extremely acid; clear smooth boundary.

Oe1—8 to 38 inches; mucky peat, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 70 percent fiber, 40 percent rubbed; massive; friable; extremely acid; clear smooth boundary.

Oe2—38 to 60 inches; mucky peat, dark reddish brown (5YR 3/2) broken, rubbed, and pressed; about 70 percent fiber, 40 percent rubbed; massive; friable; extremely acid.

Range in Characteristics*Oi horizon:*

Hue—10YR or 7.5YR
Value—2 to 6
Chroma—1 to 4
Kind of material—fibric
Content of fibers—90 to 100 percent unrubbed; 65 to 80 percent rubbed

Oe horizon:

Hue—10YR, 7.5YR, or 5YR
Value—2 to 4
Chroma—2 to 4
Content of fibers—35 to 75 percent unrubbed; 20 to 45 percent rubbed

Hiwood Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Outwash plains and till-floored glacial lake plains

Parent material: Sandy sediments

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Hiwood loamy fine sand, 2,200 feet south and 2,400 feet east of the northwest corner of sec. 34, T. 144 N., R. 31 W.

A—0 to 2 inches; very dark brown (10YR 2/2) loamy fine sand, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; strongly acid; abrupt smooth boundary.

E—2 to 5 inches; very dark grayish brown (10YR 4/2) loamy fine sand, dark brown (10YR 4/3) dry; weak very fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

Bw1—5 to 9 inches; dark brown (10YR 4/3) loamy fine sand; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

Bw2—9 to 14 inches; dark yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

Bw3—14 to 30 inches; yellowish brown (10YR 5/4) loamy fine sand; common fine faint brown (10YR 5/3) and few fine distinct yellowish brown (10YR

5/6) mottles; weak very fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

C—30 to 60 inches; grayish brown (10YR 5/2) fine sand; common fine distinct brownish yellow (10YR 6/6), few fine distinct light brownish gray (2.5Y 6/2), and few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 2 percent

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 or 2

Texture—fine sand or loamy fine sand

Bw horizon:

Hue—10YR

Value—4 to 6

Chroma—3 to 6

Texture—fine sand or loamy fine sand

C horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—fine sand or sand

Hubbard Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and valley trains

Parent material: Sandy outwash

Slope range: 0 to 8 percent

Taxonomic class: Sandy, mixed Udorthentic
Haploborolls

Typical Pedon

Hubbard loamy sand, 0 to 3 percent slopes, 250 feet north and 1,390 feet east of the southwest corner of sec. 21, T. 133 N., R. 29 W.

A1—0 to 10 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; many very fine roots; moderately acid; abrupt smooth boundary.

A2—10 to 16 inches; very dark brown (10YR 2/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine

subangular blocky structure; very friable; many very fine roots; moderately acid; clear wavy boundary.

Bw1—16 to 24 inches; dark brown (10YR 3/3) loamy sand; weak fine subangular blocky structure; very friable; common very fine roots; moderately acid; clear wavy boundary.

Bw2—24 to 34 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few very fine roots; moderately acid; gradual wavy boundary.

C1—34 to 44 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; about 1 percent gravel; moderately acid; gradual wavy boundary.

C2—44 to 49 inches; dark brown (10YR 4/3) sand; single grain; loose; about 2 percent gravel; moderately acid; gradual wavy boundary.

C3—49 to 60 inches; dark brown (10YR 4/3) sand; single grain; loose; about 5 percent gravel; moderately acid.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 26 inches

Content of rock fragments: 0 to 10 percent

Other features: An AB horizon in some pedons; a BC horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, or sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 5

Texture—coarse sand or sand

Huntersville Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—very slow

Landform: Drumlins

Parent material: Sandy mantle and the underlying dense till

Slope range: 1 to 6 percent

Taxonomic class: Loamy, mixed Aquic Arenic
Eutroboralfs

Typical Pedon

Huntersville loamy sand, acid substratum, 1 to 6

percent slopes, 630 feet east and 900 feet south of the northwest corner of sec. 5, T. 133 N., R. 31 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; many very fine roots; about 2 percent gravel; strongly acid; abrupt smooth boundary.

E/B—7 to 14 inches; about 60 percent grayish brown (10YR 5/2) loamy sand (E) and 40 percent yellowish brown (10YR 5/6) loamy sand (B); weak fine subangular blocky structure; very friable; many very fine roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw—14 to 26 inches; yellowish brown (10YR 5/6) loamy sand; common fine prominent light brownish gray (2.5Y 6/2) mottles; weak fine subangular blocky structure; very friable; few very fine roots; about 3 percent gravel; strongly acid; clear wavy boundary.

2Bt1—26 to 32 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct light gray (10YR 6/1) and common medium distinct brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure parting to weak medium subangular blocky; friable; few very fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 6 percent gravel; strongly acid; gradual wavy boundary.

2Bt2—32 to 58 inches; yellowish brown (10YR 5/4) sandy loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few faint brown (10YR 5/3) clay films on faces of peds; about 6 percent gravel; moderately acid; clear wavy boundary.

2Cd—58 to 60 inches; light brownish gray (10YR 6/2) sandy loam; common coarse prominent strong brown (7.5YR 5/6) mottles; massive; weak thick platy fragments; firm; about 6 percent gravel; strongly acid.

Range in Characteristics

Special features: An EB, BE, or B/E horizon in some pedons; a BC horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand

Content of rock fragments—0 to 15 percent

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 or 3

Texture—sandy loam, loamy sand, sand, loamy fine sand, or fine sand

Content of rock fragments—0 to 15 percent

E/B horizon:

Colors—similar to those of the E and Bw horizons

Textures—similar to those of the E and Bw horizons

Bw horizon (if it occurs):

Hue—10YR

Value—4 to 6

Chroma—3 to 6

Texture—sand, loamy sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 15 percent gravel; 0 to 10 percent cobbles

2Bt horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—4 to 6

Texture—sandy loam

Content of rock fragments—0 to 15 percent gravel; 0 to 10 percent cobbles

2Cd horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—sandy loam or loamy sand

Content of rock fragments—0 to 15 percent gravel; 0 to 10 percent cobbles

Itasca Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Silty mantle and the underlying loamy till

Slope range: 1 to 15 percent

Taxonomic class: Coarse-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Itasca silt loam, in an area of Itasca-Goodland complex, 1 to 8 percent slopes, 1,000 feet east and 1,500 feet south of the northwest corner of sec. 13, T. 140 N., R. 25 W.

E—0 to 3 inches; dark brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; moderate very fine subangular blocky structure; very friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.

Bw—3 to 12 inches; brown (10YR 5/3) silt loam; weak thin platy structure; very friable; many fine and very

fine roots; slightly acid; clear smooth boundary.

E'—12 to 20 inches; grayish brown (10YR 6/3) silt loam; weak thin platy structure; friable; many fine and very fine roots; moderately acid; clear smooth boundary.

E/B—20 to 25 inches; about 60 percent grayish brown (10YR 6/3) silt loam (E) and 40 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); moderate fine subangular blocky structure; friable; common fine roots; about 3 percent gravel; moderately acid; clear wavy boundary.

2Bt—25 to 43 inches; brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky structure; firm; common fine roots; many faint dark brown (7.5YR 3/4) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

2C—43 to 60 inches; yellowish brown (10YR 5/4) sandy loam; massive; firm; few roots; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 48 to more than 72 inches

Other features: Some pedons have a 2E/B horizon, a 2B/E horizon, or both.

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

Texture—silt loam

Content of rock fragments—0 to 2 percent

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 6

Chroma—3 or 4

Texture—silt loam or very fine sandy loam

Content of rock fragments—0 to 2 percent

E' horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 or 3

Texture—silt loam, very fine sandy loam, fine sandy loam, or loamy very fine sand

Content of rock fragments—0 to 2 percent

2E/B or 2B/E horizon (if it occurs):

Colors—similar to those of the E' and Bt horizons

Textures—similar to those of the E' and Bt horizons

2Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—2 to 10 percent

2C horizon:

Hue—7.5YR, 2.5Y, or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—fine sandy loam, sandy loam, or loam

Content of rock fragments—2 to 10 percent

Lupton Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landform: Lake plains, outwash plains, and moraines

Parent material: Highly decomposed, woody organic materials

Slope range: 0 to 1 percent

Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Lupton muck, in an area of Mooselake and Lupton soils, 1,500 feet east and 2,500 feet south of the northwest corner of sec. 7, T. 140 N., R. 25 W.

Oa1—0 to 25 inches; muck, dark reddish brown (5YR 2.5/2) broken face, dark reddish brown (5YR 3/2) rubbed and pressed; about 15 percent fiber, 5 percent rubbed; weak medium platy structure; very friable; about 15 percent woody fragments larger than 2 millimeters; slightly alkaline; abrupt wavy boundary.

Oa2—25 to 60 inches; muck, dark reddish brown (5YR 3/2) broken face, dark brown (7.5YR 3/2) rubbed and pressed; about 10 percent fiber, 3 percent rubbed; weak thin platy structure; very friable; about 30 percent woody fragments larger than 2 millimeters; slightly alkaline.

Range in Characteristics

Oa horizon:

Hue—7.5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Thickness—16 to 50 inches

Kind of material—sapric

Content of fibers—5 to 60 percent unrubbed; 0 to 10 percent rubbed

Content of wood fragments greater than 2 millimeters in size—0 to 30 percent

Mahtomedi Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains and moraines

Parent material: Sandy outwash

Slope range: 1 to 40 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Mahtomedi loamy sand, 8 to 15 percent slopes, 1,100 feet south and 2,600 feet west of the northeast corner of sec. 28, T. 140 N., R. 31 W.

A—0 to 2 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; common fine roots; about 8 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 6 inches; dark brown (7.5YR 4/2) gravelly loamy sand; weak fine subangular blocky structure; very friable; common very fine roots; about 20 percent gravel; strongly acid; clear smooth boundary.

Bw1—6 to 11 inches; dark brown (7.5YR 4/4) sand; single grain; loose; few very fine roots; about 8 percent gravel; strongly acid; clear smooth boundary.

Bw2—11 to 18 inches; brown (7.5YR 5/4) gravelly sand; single grain; loose; about 18 percent gravel; strongly acid; clear smooth boundary.

Bw3—18 to 22 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 20 percent gravel; strongly acid; clear smooth boundary.

C1—22 to 36 inches; brown (10YR 5/3) gravelly sand; single grain; loose; about 18 percent gravel; strongly acid; clear smooth boundary.

C2—36 to 48 inches; dark brown (10YR 4/3) gravelly sand; single grain; loose; about 20 percent gravel; strongly acid; gradual smooth boundary.

C3—48 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 5 percent gravel; slightly acid.

Range in Characteristics

Special features: A BC horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Content of rock fragments—0 to 15 percent

E horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—1 to 3

Texture—loamy sand, sand, loamy coarse sand, coarse sand, loamy fine sand, or the gravelly analogs of these textures

Content of rock fragments—10 to 35 percent

Bw horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—4 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—10 to 35 percent

C horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—3 or 4

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—10 to 35 percent

Markey Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Till-floored glacial lake plains, outwash plains, and moraines

Parent material: Herbaceous organic material underlain by sandy sediments

Slope range: 0 to 2 percent

Taxonomic class: Sandy or sandy-skeletal, mixed, euic Terric Borosaprists

Typical Pedon

Markey muck, 1,600 feet west and 1,100 feet south of the northeast corner of sec. 13, T. 133 N., R. 31 W.

Oa—0 to 30 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 15 percent fiber, 1 percent rubbed; weak medium subangular blocky structure; moderately acid; abrupt smooth boundary.

Cg—30 to 60 inches; gray (5Y 5/1) sand; single grain; loose; moderately acid.

Range in Characteristics

Oa horizon:

Hue—7.5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Thickness—16 to 50 inches

Kind of material—sapric

Content of fibers—5 to 60 percent unrubbed; 0 to 20 percent rubbed

Cg horizon:

Hue—10YR to 5G

Value—4 to 6

Chroma—1 to 4

Texture—sand or coarse sand

Meehan Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Outwash plains

Parent material: Sandy outwash

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 1,250 feet south and 175 feet east of the northwest corner of sec. 4, T. 135 N., R. 32 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; very friable; about 5 percent gravel; strongly acid; abrupt smooth boundary.

E1—7 to 9 inches; dark brown (10YR 4/3) sand; few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; strongly acid; clear smooth boundary.

E2—9 to 18 inches; pale brown (10YR 6/3) sand; few fine prominent strong brown (7.5YR 5/6) and few fine faint light gray (10YR 7/2) mottles; weak fine subangular blocky structure; very friable; very strongly acid; clear smooth boundary.

Bw—18 to 24 inches; strong brown (7.5YR 4/6) sand; many medium distinct pinkish gray (7.5YR 7/2) and many fine distinct yellowish red (5YR 5/6) mottles; single grain; loose; about 3 percent gravel; strongly acid; clear wavy boundary.

C—24 to 60 inches; grayish brown (2.5Y 5/2) sand; many coarse prominent strong brown (7.5YR 5/6) and many medium prominent strong brown (7.5YR 5/8) mottles; single grain; loose; about 4 percent gravel; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

Other features: A BC horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

E horizon:

Hue—7.5Y or 10YR

Value—4 to 6

Chroma—2 or 3

Texture—sand or loamy sand

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—sand, loamy sand, coarse sand, or loamy coarse sand

C horizon:

Hue—7.5YR or 10YR

Value—4 to 7

Chroma—2 to 4

Texture—sand or coarse sand

Menahga Series

Depth class: Very deep

Drainage class: Excessively drained and well drained

Permeability: Upper part—rapid; lower part—rapid, moderate, or very slow

Landform: Outwash plains, moraines, and drumlins

Parent material: Sandy outwash

Slope range: 0 to 40 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical Pedon

Menahga loamy sand, 3 to 8 percent slopes, 500 feet south and 2,580 feet west of the northeast corner of sec. 20, T. 135 N., R. 32 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loamy sand, brown (10YR 5/3) dry; single grain; loose; many fine roots; moderately acid; abrupt smooth boundary.

Bw1—3 to 12 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common fine roots; moderately acid; clear smooth boundary.

Bw2—12 to 20 inches; yellowish brown (10YR 5/6) sand; single grain; loose; few fine roots; moderately acid; gradual smooth boundary.

C—20 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few fine roots; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

Other features: An AB horizon in some pedons; an E horizon in some pedons; a BC horizon in some pedons; a 2C horizon below a depth of 40 inches in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand or loamy coarse sand

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

Texture—sand, loamy sand, coarse sand, or loamy coarse sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—coarse sand or sand

2C horizon (if it occurs):

Texture—sandy loam, fine sandy loam, clay loam, or loam

Mooselake Series*Depth class:* Very deep*Drainage class:* Very poorly drained*Permeability:* Moderately rapid*Landform:* Moraines, outwash plains, and till-floored glacial lake plains*Parent material:* Moderately decomposed, woody organic material*Slope range:* 0 to 1 percent*Taxonomic class:* Euic Typic Borohemists**Typical Pedon**

Mooselake mucky peat, in an area of Mooselake and Lupton soils, 2,100 feet south and 500 feet west of the northeast corner of sec. 1, T. 143 N., R. 26 W.

Oe1—0 to 8 inches; mucky peat, black (5YR 2.5/1) broken face, rubbed, and pressed; about 50 percent fiber, 20 percent rubbed; moderate medium granular structure; very friable; about 5 percent woody fragments; slightly acid; clear smooth boundary.

Oe2—8 to 18 inches; mucky peat, black (5YR 2.5/1) broken face, rubbed, and pressed; about 70 percent fiber, 25 percent rubbed; moderate medium granular structure; very friable; about 15 percent woody fragments; neutral; gradual smooth boundary.

Oe3—18 to 29 inches; mucky peat, dark brown (5YR 2.5/1) broken face, rubbed, and pressed; about 60 percent fiber, 20 percent rubbed; moderate medium granular structure; very friable; about 10 percent woody fragments; neutral; clear smooth boundary.

Oa—29 to 35 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 40 percent fiber, 5 percent rubbed; moderate medium granular structure; about 8 percent woody fragments; friable; neutral; clear smooth boundary.

O'e1—35 to 43 inches; mucky peat, dark reddish brown (5YR 2.5/2) broken face, rubbed, and pressed;

about 40 percent fiber, 20 percent rubbed; weak fine granular structure; very friable; neutral; gradual smooth boundary.

O'e2—43 to 60 inches; mucky peat, black (5YR 2.5/1) broken face, rubbed, and pressed; about 35 percent fiber, 20 percent rubbed; massive; very friable; about 8 percent woody fragments larger than 2 millimeters; neutral.

Range in Characteristics*Thickness of organic material:* 51 to 100 inches*Oe and O'e horizons:*

Hue—5YR, 7.5YR, or 10YR

Value—2 to 4

Chroma—2 to 4

Kind of material—hemic

Content of fibers—35 to 75 percent unrubbed; 15 to 45 percent rubbed

Content of wood fragments greater than 2 millimeters in size—0 to 15 percent

Oa horizon:

Hue—7.5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Kind of material—sapric

Content of fibers—5 to 60 percent unrubbed; 0 to 20 percent rubbed

Nokasippi Series*Depth class:* Very deep*Drainage class:* Very poorly drained*Permeability:* Upper part—rapid; lower part—very slow*Landform:* Drumlins and moraines*Parent material:* Sandy mantle and the underlying dense till*Slope range:* 0 to 1 percent*Taxonomic class:* Coarse-loamy, mixed, frigid Typic Epiaquolls**Typical Pedon**

Nokasippi loamy fine sand, 500 feet south of the northeast corner of sec. 16, T. 139 N., R. 28 W.

Oe—4 inches to 0; black (N 2/0) mucky peat; very friable; many fine roots; about 1 percent gravel; abrupt smooth boundary.

A—0 to 10 inches; black (10YR 3/1) loamy fine sand, very dark gray (10YR 3/1) dry; moderate medium granular structure; very friable; many fine roots; about 1 percent gravel; very strongly acid; abrupt smooth boundary.

Bg1—10 to 21 inches; gray (10YR 5/1) loamy sand; moderate fine subangular blocky structure; friable;

few very fine roots; about 1 percent gravel; very strongly acid; clear smooth boundary.

Bg2—21 to 32 inches; grayish brown (2.5Y 5/2) loamy sand; moderate fine subangular blocky structure; friable; few very fine roots; about 2 percent gravel; very strongly acid; clear wavy boundary.

2Bg3—32 to 41 inches; grayish brown (2.5Y 5/2) sandy loam; many medium prominent strong brown (7.5YR 5/8) and common fine distinct brown (10YR 5/3) mottles; moderate fine subangular blocky structure; friable; about 9 percent gravel; very strongly acid; clear wavy boundary.

2BC—41 to 49 inches; dark brown (7.5YR 4/4) sandy loam; common medium prominent pale brown (10YR 6/3) and common fine prominent strong brown (7.5YR 5/8) mottles; massive; firm; about 9 percent gravel; very strongly acid; gradual smooth boundary.

2Cd—49 to 60 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct brown (10YR 5/3) and common fine prominent strong brown (7.5YR 5/8) mottles; massive; very firm; about 10 percent gravel; strongly acid.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 16 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loamy fine sand

Content of rock fragments—0 to 2 percent

Bg horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—loamy fine sand, fine sand, or loamy sand

Content of rock fragments—0 to 2 percent

2Bg horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—5 to 15 percent

2BC horizon (if it occurs):

Colors—similar to those of the 2Cd horizon

Textures—similar to those of the 2Cd horizon

2Cd horizon:

Hue—7.5YR

Value—3 to 5

Chroma—3 to 5

Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures

Content of rock fragments—5 to 15 percent

Nokay Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—very slow

Landform: Drumlins and ground moraines

Parent material: Dense till

Slope range: 0 to 2 percent

Taxonomic class: Coarse-loamy, mixed, frigid Udollic Epiaqualfs

Typical Pedon

Nokay loam, 2,580 feet west and 150 feet south of the northeast corner of sec. 24, T. 139 N., R. 28 W.

A—0 to 5 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; about 4 percent gravel; very strongly acid; abrupt wavy boundary.

E1—5 to 10 inches; grayish brown (2.5Y 5/2) loam; moderate medium platy structure; friable; about 3 percent gravel; very strongly acid; clear wavy boundary.

E2—10 to 17 inches; grayish brown (2.5Y 5/2) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; about 5 percent gravel; very strongly acid; clear wavy boundary.

Bt—17 to 32 inches; brown (7.5YR 5/4) sandy loam; common coarse prominent light brownish gray (2.5Y 6/2) mottles; moderate fine subangular blocky structure; friable; common faint dark brown (7.5YR 4/4) clay films on faces of peds; many light brownish gray (2.5Y 6/2) coatings on faces of peds; about 3 percent gravel; strongly acid; abrupt wavy boundary.

BC—32 to 44 inches; dark brown (7.5YR 4/4) loamy coarse sand; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium platy structure parting to moderate very fine subangular blocky; firm; about 6 percent gravel; moderately acid; clear smooth boundary.

Cd—44 to 60 inches; brown (7.5YR 5/4) loamy coarse sand; common coarse distinct strong brown (7.5YR 5/8) and common medium prominent grayish brown (10YR 5/2) mottles; massive; moderate medium platy fragments; very firm; about 7 percent gravel; moderately acid.

Range in Characteristics

Depth to dense till: 30 to 50 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—2 to 15 percent

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—2 to 15 percent

Bt horizon:

Hue—7.5YR

Value—4 or 5

Chroma—2 to 6

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—2 to 15 percent

BC horizon (if it occurs):

Colors—similar to those of the Cd horizon

Textures—similar to those of the Cd horizon

Cd horizon:

Hue—7.5YR

Value—4 or 5

Chroma—3 to 5

Texture—sandy loam, loamy coarse sand, loamy sand, fine sandy loam, or the gravelly analogs of these textures

Content of rock fragments—5 to 20 percent

Paddock Series*Depth class:* Very deep*Drainage class:* Somewhat poorly drained*Permeability:* Upper part—moderate; lower part—very slow*Landform:* Drumlins*Parent material:* Dense till*Slope range:* 0 to 2 percent*Taxonomic class:* Coarse-loamy, mixed, frigid Udollic Epiaqualfs**Typical Pedon**

Paddock loam, acid substratum, 2,060 feet west and 1,450 feet north of the southeast corner of sec. 2, T. 133 N., R. 31 W.

A—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; many very fine roots; about 2 percent gravel; strongly acid; abrupt smooth boundary.

E—7 to 13 inches; dark grayish brown (10YR 4/2) sandy loam; weak medium platy structure; firm;

common very fine roots; about 2 percent gravel; strongly acid; clear smooth boundary.

BE—13 to 20 inches; grayish brown (10YR 5/2) sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common very fine roots; about 2 percent gravel; strongly acid; clear smooth boundary.

Bt1—20 to 31 inches; yellowish brown (10YR 5/4) sandy loam; common medium distinct light brownish gray (2.5Y 6/2) and many fine prominent yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few very fine roots; few distinct grayish brown (10YR 5/2) clay films on faces of peds; common light brownish gray (10YR 6/2) silt coatings on faces of peds; about 2 percent gravel; strongly acid; clear smooth boundary.

Bt2—31 to 41 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct light gray (10YR 6/1) and many fine distinct dark yellowish brown (10YR 4/6) mottles; strong medium subangular blocky structure; firm; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 3 percent gravel; moderately acid; clear smooth boundary.

BC—41 to 45 inches; brown (10YR 5/3) sandy loam; many coarse prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; about 3 percent gravel; strongly acid; gradual smooth boundary.

Cd—45 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; about 3 percent gravel; moderately acid.

Range in Characteristics*Content of rock fragments:* 2 to 10 percent*Depth to carbonates:* 40 to more than 60 inches*Other features:* An EB, B/E, or E/B horizon in some pedons*A or Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or fine sandy loam

BE horizon (if it occurs):

Colors—similar to those of the Bt and E horizons

Textures—similar to those of the Bt and E horizons

Bt horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy loam

BC horizon:

Colors—similar to those of the Cd horizon
 Textures—similar to those of the Cd horizon

Cd horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—3 or 4
 Texture—sandy loam or loamy sand

Pomroy Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Landform: Drumlins and moraines

Parent material: Sandy mantle and the underlying dense till

Slope range: 3 to 15 percent

Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Pomroy loamy sand, 3 to 8 percent slopes, 800 feet west and 2,270 feet south of the northeast corner of sec. 33, T. 139 N., R. 26 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; very friable; about 2 percent gravel; moderately acid; abrupt smooth boundary.

Bw—4 to 14 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; friable; about 2 percent gravel; slightly acid; clear smooth boundary.

E—14 to 24 inches; brown (10YR 5/3) fine sand; weak fine subangular blocky structure; friable; about 1 percent gravel; slightly acid; clear smooth boundary.

2Bt—24 to 31 inches; brown (7.5YR 5/4) sandy loam; few fine distinct strong brown (7.5YR 5/6) and common fine distinct brown (10YR 5/3) mottles; weak thick platy structure parting to moderate fine subangular blocky; firm; few faint dark brown (7.5YR 4/4) clay films on faces of peds; few wedges of brown (10YR 5/3) fine sand; about 2 percent gravel; slightly acid; clear smooth boundary.

2BC—31 to 42 inches; dark brown (7.5YR 4/4) sandy loam; few medium distinct strong brown (7.5YR 5/6) mottles; strong very thick platy fragments parting to weak medium subangular blocky structure; very

firm; about 5 percent gravel; slightly acid; gradual wavy boundary.

2Cd—42 to 60 inches; dark brown (7.5YR 4/4) sandy loam; strong very thick platy soil fragments; very firm; about 5 percent gravel; slightly acid.

Range in Characteristics*A or Ap horizon:*

Hue—10YR
 Value—2 to 4
 Chroma—1 to 3
 Texture—loamy sand
 Content of rock fragments—0 to 2 percent

E horizon (if it occurs):

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—2 or 3
 Texture—sand, loamy fine sand, or fine sand
 Content of rock fragments—0 to 2 percent

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—fine sand, loamy fine sand, loamy sand, or sand
 Content of rock fragments—0 to 2 percent

2Bt horizon:

Hue—7.5YR or 5YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures
 Content of rock fragments—5 to 20 percent

2BC horizon (if it occurs):

Colors—similar to those of the 2Cd horizon
 Textures—similar to those of the 2Cd horizon

2Cd horizon:

Hue—7.5YR or 5YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—sandy loam, fine sandy loam, or the gravelly analogs of these textures
 Content of rock fragments—5 to 20 percent

Redby Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Rapid

Landform: Till-floored glacial lake plains

Parent material: Sandy sediments

Slope range: 1 to 3 percent

Taxonomic class: Mixed, frigid Aquic Udipsamments

Typical Pedon

Redby fine sand, 2,680 feet south and 50 feet east of the northwest corner of sec. 23, T. 151 N., R. 32 W., in Beltrami County. *Note:* In Cass County, mapped areas of the Redby soil occur only within the boundaries of the Chippewa National Forest.

- A—0 to 3 inches; very dark gray (10YR 3/1) fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; moderately acid; abrupt wavy boundary.
- E—3 to 8 inches; grayish brown (10YR 5/2) fine sand, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; moderately acid; clear wavy boundary.
- Bw—8 to 30 inches; yellowish brown (10YR 5/4) fine sand; common medium distinct light brownish gray (10YR 6/2) and common medium prominent strong brown (7.5YR 4/6) and reddish brown (5YR 4/4) mottles; single grain; loose; slightly acid; clear wavy boundary.
- C—30 to 60 inches; light brownish gray (10YR 6/2) fine sand; common medium prominent strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: 30 to 80 inches

Content of rock fragments: 0 to 2 percent gravel

A horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand

E horizon:

Hue—10YR
Value—4 to 6
Chroma—1 to 3
Texture—loamy fine sand or fine sand

Bw horizon:

Hue—10YR
Value—4 to 6
Chroma—3 to 6
Texture—fine sand or sand

C horizon:

Hue—10YR or 2.5Y
Value—5 to 7
Chroma—2 or 3
Texture—fine sand or sand

Redeye Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—very slow

Landform: Drumlins

Parent material: Sandy mantle and the underlying dense till

Slope range: 1 to 12 percent

Taxonomic class: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Redeye loamy sand, acid substratum, 1 to 6 percent slopes, 300 feet south and 480 feet east of the northwest corner of sec. 5, T. 133 N., R. 31 W.

- Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; very friable; many very fine roots; about 5 percent gravel; strongly acid; abrupt smooth boundary.
- E—6 to 15 inches; dark brown (10YR 4/3) loamy fine sand; single grain; loose; many very fine roots; about 5 percent gravel; strongly acid; clear smooth boundary.
- Bw1—15 to 21 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; very friable; common very fine roots; about 5 percent gravel; strongly acid; clear smooth boundary.
- Bw2—21 to 33 inches; yellowish brown (10YR 5/6) sand; single grain; loose; common very fine roots; about 2 percent gravel; strongly acid; clear wavy boundary.
- 2Bt—33 to 55 inches; yellowish brown (10YR 5/6) sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; few distinct brown (10YR 5/3) clay films on faces of peds; about 5 percent gravel; strongly acid; clear smooth boundary.
- 2Cd—55 to 60 inches; yellowish brown (10YR 5/4) sandy loam; massive; firm; about 5 percent gravel; moderately acid.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Other features: An EB or BE horizon in some pedons; a 2BC horizon in some pedons

A or Ap horizon:

Hue—10YR
Value—2 to 4
Chroma—1 to 3
Texture—loamy sand
Content of rock fragments—0 to 15 percent

E horizon:

Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 or 3

Texture—loamy sand, loamy fine sand, sand, or fine sand

Content of rock fragments—0 to 15 percent

Bw horizon:

Hue—10YR

Value—4 to 6

Chroma—4 to 6

Texture—sand or loamy sand

Content of rock fragments—0 to 15 percent

2Bt horizon:

Hue—10YR

Value—4 or 5

Chroma—4 to 6

Texture—sandy loam

Content of rock fragments—2 to 15 percent

2Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—4 or 5

Texture—sandy loam or loamy sand

Content of rock fragments—2 to 15 percent

Rifle Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately rapid

Landform: Moraines, outwash plains, and till-floored glacial lake plains

Parent material: Moderately decomposed, dominantly herbaceous organic material

Slope range: 0 to 2 percent

Taxonomic class: Euic Typic Borohemists

Typical Pedon

Rifle mucky peat, 1,000 feet south and 1,015 feet east of the northwest corner of sec. 29, T. 138 N., R. 32 W.

Oe1—0 to 11 inches; mucky peat, dark reddish brown (5YR 3/2) broken face, dark brown (7.5YR 3/2) rubbed and pressed; about 70 percent fiber, 55 percent rubbed; weak fine subangular blocky structure; moderately acid; clear smooth boundary.

Oe2—11 to 26 inches; mucky peat, very dark grayish brown (10YR 3/2) broken face, dark brown (7.5YR 3/2) rubbed and pressed; about 70 percent fiber, 40 percent rubbed; massive; moderately acid; clear smooth boundary.

Oe3—26 to 50 inches; mucky peat, dark reddish brown (5YR 2.5/2) broken face, reddish brown (5YR 4/3) rubbed and pressed; about 60 percent fiber, 35 percent rubbed; massive; moderately acid; clear smooth boundary.

Oe4—50 to 60 inches; mucky peat, dark brown (7.5YR

3/2) broken face, rubbed, and pressed; about 60 percent fiber, 35 percent rubbed; massive; moderately acid.

Range in Characteristics

Oe horizon:

Hue—5YR, 7.5YR, or 10YR

Value—2 to 4

Chroma—2 to 4

Thickness—60 to 100 inches

Kind of material—hemic

Content of fibers—60 to 80 percent unrubbed; 20 to 30 percent rubbed

Content of wood fragments greater than 2 millimeters in size—0 to 15 percent

Roscommon Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Rapid

Landform: Outwash plains and till-floored glacial lake plains

Parent material: Sandy outwash or lacustrine sediments

Slope range: 0 to 2 percent

Taxonomic class: Mixed, frigid Mollic Psammaquents

Typical Pedon

Roscommon loamy sand, 1,100 feet west and 2,000 feet north of the southeast corner of sec. 4, T. 138 N., R. 32 W.

A—0 to 6 inches; very dark gray (10YR 3/1) loamy sand, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; many very fine roots; moderately acid; abrupt smooth boundary.

Cg1—6 to 24 inches; brown (10YR 5/3) sand; common medium distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; single grain; loose; few very fine roots; about 1 percent gravel; moderately acid; gradual smooth boundary.

Cg2—24 to 60 inches; gray (10YR 5/2) sand; common fine prominent light olive brown (2.5Y 5/4) mottles; single grain; loose; few very fine roots; about 2 percent gravel; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 10 percent

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Cg horizon:

Hue—10YR, 7.5YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—sand, coarse sand, loamy sand, or loamy coarse sand

Runeberg Series*Depth class:* Very deep*Drainage class:* Very poorly drained*Permeability:* Moderately slow or slow*Landform:* Drumlins and moraines*Parent material:* Till*Slope range:* 0 to 2 percent*Taxonomic class:* Coarse-loamy, mixed, frigid Typic Endoaquolls**Typical Pedon**

Runeberg mucky loam, depressional, 400 feet south and 1,325 feet east of the northwest corner of sec. 23, T. 136 N., R. 35 W.

A1—0 to 3 inches; black (10YR 2/1) mucky loam, black (10YR 2/1) dry; weak fine granular structure; friable; about 3 percent gravel; neutral; abrupt smooth boundary.

A2—3 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

A3—9 to 13 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; common fine faint dark gray (10YR 4/1) and common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

Bg1—13 to 19 inches; dark grayish brown (10YR 4/2) loam; few medium distinct greenish gray (5GY 5/1) and gray (5Y 5/1) and common medium and coarse prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

Bg2—19 to 26 inches; olive gray (5Y 5/2) sandy loam; common fine faint gray (5Y 5/1) and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; about 3 percent gravel; neutral; clear smooth boundary.

Cg—26 to 60 inches; pale olive (5Y 6/3) sandy loam; common fine faint gray (5Y 5/1) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; about 5 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics*Depth to carbonates:* 24 to more than 60 inches*Content of rock fragments:* 3 to 15 percent*A horizon:*

Hue—10YR to 5Y

Value—2 or 3

Chroma—1 or 2

Texture—mucky loam or loam

AB horizon:

Colors—similar to those of the A or Bg horizon

Textures—similar to those of the A or Bg horizon

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam

Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—sandy loam

Sanburn Series*Depth class:* Very deep*Drainage class:* Well drained*Permeability:* Upper part—moderately rapid; lower part—rapid*Landform:* Outwash plains*Parent material:* Thin loamy mantle and the underlying sandy and gravelly sediments*Slope range:* 0 to 15 percent*Taxonomic class:* Coarse-loamy, mixed Typic Eutroboralfs**Typical Pedon**

Sanburn loamy sand, 0 to 3 percent slopes, 100 feet east and 1,000 feet north of the southwest corner of sec. 26, T. 138 N., R. 30 W.

A—0 to 2 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; many very fine roots; moderately acid; abrupt smooth boundary.

E1—2 to 6 inches; dark brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; friable; many fine roots; moderately acid; clear smooth boundary.

E2—6 to 15 inches; dark yellowish brown (10YR 4/4) loamy sand; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; moderately acid; clear smooth boundary.

Bt—15 to 21 inches; dark brown (7.5YR 4/4) sandy loam; moderate medium subangular blocky

structure; friable; common fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds; about 8 percent gravel; strongly acid; clear smooth boundary.

2BC—21 to 33 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine roots; about 8 percent gravel; strongly acid; gradual smooth boundary.

2C1—33 to 40 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 5 percent gravel; strongly acid; gradual smooth boundary.

2C2—40 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 3 percent gravel; strongly acid.

Range in Characteristics

Special features: An EB, BE, or Bw horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand or sandy loam

Content of rock fragments—0 to 10 percent

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—loamy sand, loamy coarse sand, fine sandy loam, or sandy loam

Content of rock fragments—0 to 10 percent

Bt horizon (if it occurs):

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or coarse sandy loam

Content of rock fragments—0 to 10 percent

2Bt horizon (if it occurs):

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—sandy loam, gravelly sandy loam, or gravelly loamy sand

Content of rock fragments—10 to 25 percent

2BC horizon (if it occurs):

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—3 to 35 percent

2C horizon:

Hue—7.5YR or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—3 to 35 percent

Sandwich Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—moderately slow

Landform: Moraines

Parent material: Sandy mantle and the underlying till or lacustrine sediments

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic Glossaqualfs

Typical Pedon

Sandwich loamy sand, 2,500 feet south and 250 feet east of the northwest corner of sec. 19, T. 145 N., R. 31 W.

A—0 to 5 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; about 1 percent gravel; moderately acid; abrupt smooth boundary.

E—5 to 16 inches; dark grayish brown (2.5Y 4/2) loamy sand; few fine prominent dark brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; very friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bw—16 to 28 inches; yellowish brown (10YR 5/4) loamy fine sand; common medium prominent grayish brown (2.5Y 5/2), few medium prominent strong brown (7.5YR 4/6), and common fine faint dark brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; friable; few medium roots; about 1 percent gravel; slightly acid; clear smooth boundary.

2B/E—28 to 35 inches; about 60 percent yellowish brown (10YR 5/3) loam (Bt) and 40 percent grayish brown (10YR 5/2) fine sandy loam (E); many medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; friable; few fine roots; few faint brown (10YR 5/3) clay films on faces of peds; about 4 percent gravel; slightly acid; clear wavy boundary.

2Btg—35 to 43 inches; grayish brown (2.5Y 5/2) clay loam; many medium prominent strong brown (7.5YR 5/8) mottles; moderate fine and medium subangular blocky structure; friable; common distinct pale

brown (10YR 6/3) clay films on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

2Cg1—43 to 50 inches; grayish brown (2.5Y 5/2) clay loam; many medium prominent dark brown (7.5YR 4/4) mottles; weak very fine subangular blocky structure; friable; about 6 percent gravel; neutral; strong effervescence; clear smooth boundary.

2Cg2—50 to 60 inches; dark grayish brown (2.5Y 4/2) loam; many medium prominent dark brown (7.5YR 4/4) and common medium prominent dark brown (7.5YR 3/2) mottles; massive; friable; common very dark grayish brown (2.5Y 3/2) manganese coatings in pores; about 6 percent gravel; neutral; strong effervescence.

Range in Characteristics

Depth to carbonates: 32 to 56 inches

Other features: An E' or 2E horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Content of rock fragments—0 to 10 percent

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—loamy sand, loamy fine sand, fine sand, or sand

Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—10YR to 2.5Y

Value—3 to 6

Chroma—2 to 4

Texture—loamy sand, loamy fine sand, loamy coarse sand, sand, fine sand, or coarse sand

Content of rock fragments—0 to 10 percent

2E horizon (if it occurs):

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—1 or 2

Texture—loam, clay loam, or sandy clay loam

Content of rock fragments—0 to 10 percent

2B/E horizon:

Colors—similar to those of the Bt and E' horizons

Textures—similar to those of the Bt and E' horizons

2Btg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

Texture—loam, clay loam, or sandy clay loam

Content of rock fragments—2 to 10 percent

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 7

Chroma—1 or 2

Texture—loam, clay loam, sandy loam, or fine sandy loam

Content of rock fragments—2 to 10 percent

Seelyville Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately rapid to moderately slow

Landform: Outwash plains, valley trains, moraines, flood plains, and till-floored glacial lake plains

Parent material: Highly decomposed, herbaceous organic material

Slope range: 0 to 2 percent

Taxonomic class: Euic Typic Borosaprists

Typical Pedon

Seelyville muck, 500 feet north of the southeast corner of sec. 29, T. 137 N., R. 32 W.

Oa1—0 to 20 inches; black (10YR 2/1 rubbed) muck; about 40 percent fiber, 10 percent rubbed; weak fine subangular blocky structure; strongly acid; clear smooth boundary.

Oa2—20 to 42 inches; dark brown (7.5YR 3/2 rubbed) muck; about 30 percent fiber, 5 percent rubbed; massive; moderately acid; gradual smooth boundary.

Oa3—42 to 60 inches; dark brown (7.5YR 3/2 rubbed) muck; about 30 percent fiber, 5 percent rubbed; massive; moderately acid.

Range in Characteristics

Oa horizon:

Hue—7.5YR, 10YR, or neutral

Value—2 or 3

Chroma—0 to 3

Kind of material—sapric

Content of fibers—20 to 60 percent unrubbed; 0 to 10 percent rubbed

Spooner Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Lake plains

Parent material: Silty lacustrine sediments

Slope range: 0 to 2 percent

Taxonomic class: Fine-silty, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Spooner very fine sandy loam, 300 feet east and 275 feet south of the northwest corner of sec. 12, T. 143 N., R. 28 W.

A—0 to 6 inches; very dark gray (10YR 3/1) very fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

E—6 to 14 inches; grayish brown (2.5Y 5/2) very fine sandy loam; weak fine subangular blocky structure; friable; many very fine roots; neutral; clear smooth boundary.

Btg—14 to 22 inches; grayish brown (2.5Y 5/2) silt loam; common fine prominent brownish yellow (10YR 6/6) and common fine prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; common very fine roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds; neutral; clear smooth boundary.

Cg1—22 to 37 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; many medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; few fine roots; slight effervescence; slightly alkaline; gradual smooth boundary.

Cg2—37 to 60 inches; light brownish gray (2.5Y 6/2) very fine sandy loam; few medium distinct light gray (10YR 6/1), common medium prominent yellowish brown (10YR 5/6), and common fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—very fine sandy loam

E horizon:

Hue—10YR to 5Y

Value—4 to 6

Chroma—1 or 2

Texture—loamy very fine sand, very fine sandy loam, loam, or silt loam

Btg horizon:

Hue—2.5Y

Value—4 or 5

Chroma—2 or 3

Texture—silt loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—very fine sandy loam, loam, or silt loam

Staples Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—rapid; lower part—very slow

Landform: Drumlins

Parent material: Sandy mantle and the underlying dense till

Slope range: 0 to 2 percent

Taxonomic class: Loamy, mixed, frigid Arenic Epiaqualfs

Typical Pedon

Staples loamy sand, acid substratum, 500 feet east and 30 feet north of the southwest corner of sec. 23, T. 136 N., R. 32 W.

Ap—0 to 4 inches; very dark brown (10YR 2/2) loamy sand, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure parting to weak medium granular; friable; many very fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Eg1—4 to 9 inches; grayish brown (10YR 5/2) loamy sand; common medium distinct yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; about 10 percent gravel; slightly acid; clear wavy boundary.

Eg2—9 to 18 inches; light brownish gray (10YR 6/2) loamy sand; common medium distinct yellowish brown (10YR 5/6), common medium faint pale brown (10YR 6/3), and few fine prominent yellowish red (5YR 5/6) mottles; moderate medium and coarse subangular blocky structure; friable; common very fine roots; about 2 percent gravel; slightly acid; clear wavy boundary.

Eg3—18 to 27 inches; brown (10YR 5/2) sand; common medium faint light brownish gray (10YR 6/2), common medium distinct yellowish brown (10YR 5/6), and few fine prominent strong brown (7.5YR 5/6) mottles; single grain; loose; friable; common very fine roots; about 5 percent gravel; slightly acid; clear wavy boundary.

2Btg—27 to 35 inches; brown (10YR 5/3) sandy loam; common coarse faint light gray (10YR 7/2) and common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium angular blocky structure; firm; few very fine roots; few faint dark yellowish brown (10YR 4/4) clay films on faces of

pedes; about 2 percent gravel; slightly acid; clear wavy boundary.

2BC—35 to 41 inches; brown (10YR 5/3) loamy sand; weak medium subangular blocky structure; very firm; about 2 percent gravel; slightly acid; clear wavy boundary.

2Cd—41 to 60 inches; yellowish brown (10YR 5/4) sandy loam; common large distinct light gray (10YR 6/1) and few medium prominent dark red (2.5YR 3/6) mottles; massive; weak thick platy fragments; very firm; about 4 percent gravel; slightly acid.

Range in Characteristics

Content of rock fragments: 0 to 15 percent

Depth to carbonates: 42 to more than 60 inches

Other features: A BE or an EB horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Eg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—loamy sand or sand

2Btg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 to 3

Texture—sandy loam

2BC horizon:

Colors—similar to those of the 2Cd horizon

Textures—similar to those of the 2Cd horizon

2Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—1 to 4

Texture—sandy loam or loamy sand

Stuntz Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic class: Fine-loamy, mixed, frigid Aeric Glossaqualfs

Typical Pedon

Stuntz very fine sandy loam, 870 feet north and 1,920 feet east of the southwest corner of sec. 32, T. 145 N., R. 30 W.

Oi—1 inch to 0; black (5YR 2/1) forest litter derived from leaves, twigs, and roots; abrupt smooth boundary.

A—0 to 1 inch; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; many roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E1—1 to 5 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) very fine sandy loam, light gray (2.5Y 7/2) dry; weak very thin platy structure; very friable; many roots; common very fine vesicular pores; about 2 percent gravel; moderately acid; clear smooth boundary.

E2—5 to 10 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, light gray (2.5Y 7/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; moderate thin and medium platy structure; very friable; many roots; common very fine vesicular pores; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E/B—10 to 17 inches; about 60 percent grayish brown (2.5Y 5/2) very fine sandy loam (E); massive; very friable; tonguing into and surrounding about 40 percent olive brown (2.5Y 4/4) and grayish brown (2.5Y 5/2) sandy clay loam (Bt); common prominent yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; firm; many roots; common very fine vesicular pores (E); about 2 percent gravel; moderately acid; clear smooth boundary.

B/E—17 to 22 inches; about 60 percent olive brown (2.5Y 4/4) sandy clay loam (Bt); moderate medium and coarse angular blocky structure; firm; few fine prominent yellowish red (5YR 5/6) mottles; about 40 percent tongues and interfingerings of grayish brown (2.5Y 5/2) very fine sandy loam (E); massive; friable; few roots; common very fine vesicular pores (E); common distinct grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) clay films and silt coatings on faces of peds (Bt); about 5 percent gravel; strongly acid; clear wavy boundary.

Btg1—22 to 27 inches; olive brown (2.5Y 4/4) sandy clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; strong medium angular blocky structure; firm; few roots; few pores; common prominent very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) clay films on faces of peds and lining pores; about 5 percent gravel;

slightly acid; clear smooth boundary.

Btg2—27 to 34 inches; light olive brown (2.5Y 5/4) clay loam; common fine prominent yellowish red (5YR 4/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; firm; few roots; few pores; many distinct grayish brown (2.5Y 5/2) clay films on faces of peds and lining pores; few prominent black (5Y 2/1) organic coatings on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Btg3—34 to 39 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish red (5YR 4/6) mottles; weak very coarse prismatic structure parting to weak coarse subangular blocky; firm; few roots; few pores; many distinct grayish brown (2.5Y 5/2) clay films on faces of peds and lining pores; few prominent black (5YR 2/1) organic coatings on faces of peds; about 5 percent gravel; slightly alkaline; clear wavy boundary.

C—39 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few roots; about 5 percent gravel; moderately alkaline; slight effervescence.

Range in Characteristics

Depth to carbonates: 32 to 60 inches

Content of rock fragments: 2 to 12 percent

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silt loam

E horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—1 or 2

Texture—very fine sandy loam, silt loam, fine sandy loam, or loam

E/B or B/E horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Btg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 or 4

Texture—sandy clay loam, clay loam, or loam

C horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—clay loam, sandy clay loam, or loam

Suomi Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Slow

Landform: Moraines

Parent material: Calcareous till

Slope range: 1 to 25 percent

Taxonomic class: Fine, mixed Glossic Eutroboralfs

Typical Pedon

Suomi loam, 1 to 6 percent slopes, about 1,000 feet east and 100 feet south of the northwest corner of sec. 6, T. 148 N., R. 34 W., in Beltrami County. *Note:* In Cass County, mapped areas of the Suomi soil occur only within the boundaries of the Chippewa National Forest.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

E—2 to 6 inches; light brownish gray (10YR 6/2) loam, light gray (10YR 7/2) dry; weak thin platy structure; friable; about 2 percent gravel; slightly acid; abrupt wavy boundary.

Bt1—6 to 14 inches; dark yellowish brown (10YR 4/4) clay; few fine faint grayish brown (10YR 5/2) mottles in the lower part; strong fine angular blocky structure; firm; many faint dark brown (10YR 3/3) clay films on faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bt2—14 to 23 inches; dark brown (10YR 3/3) clay; common fine distinct light brownish gray (2.5Y 6/2) mottles; moderate coarse subangular blocky structure; firm; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bkg—23 to 60 inches; grayish brown (2.5Y 5/2) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; common fine irregularly shaped carbonates in soft masses; about 3 percent gravel; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Content of rock fragments: 1 to 6 percent gravel

Other features: A B/E or an E/B horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam, silt loam, fine sandy loam, or very fine sandy loam

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—clay, silty clay, silty clay loam, or clay loam

Bkg horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—1 to 4

Texture—clay, silty clay, silty clay loam, clay loam, or loam

Wabedo Series*Depth class:* Very deep*Drainage class:* Moderately well drained*Permeability:* Upper part—moderate; lower part—very slow*Landform:* Drumlins and moraines*Parent material:* Dense till*Slope range:* 1 to 6 percent*Taxonomic class:* Coarse-loamy, mixed, frigid Aquic Dystric Eutrochrepts**Typical Pedon**

Wabedo sandy loam, 1 to 6 percent slopes, 500 feet south and 1,000 feet west of the northeast corner of sec. 13, T. 139 N., R. 28 W.

A—0 to 5 inches; very dark brown (10YR 2/2) sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; about 2 percent gravel; very strongly acid; abrupt wavy boundary.

Bw1—5 to 8 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; very friable; about 3 percent gravel; strongly acid; clear wavy boundary.

Bw2—8 to 15 inches; dark brown (10YR 4/3) and yellowish brown (10YR 4/4) sandy loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; about 2 percent gravel; very strongly acid; clear wavy boundary.

Bw3—15 to 27 inches; dark yellowish brown (10YR 4/4) and dark brown (10YR 4/3) sandy loam; few fine distinct grayish brown (10YR 5/2), few fine distinct yellowish brown (10YR 5/6), and few fine prominent

strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; about 3 percent gravel; strongly acid; abrupt wavy boundary.

BC—27 to 47 inches; dark brown (7.5YR 4/4) sandy loam; common fine prominent grayish brown (10YR 5/2) and common fine distinct strong brown (7.5YR 5/6) mottles; strong thick platy structure parting to moderate fine subangular blocky; very firm, moderately brittle; about 8 percent gravel; strongly acid; clear smooth boundary.

Cd—47 to 60 inches; strong brown (7.5YR 4/6) sandy loam; common medium prominent grayish brown (10YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; massive; moderate firm thick platy soil fragments; very firm, brittle; about 10 percent gravel; moderately acid.

Range in Characteristics

Special features: An E horizon in some pedons; an EB or BE horizon in some pedons

A or Ap horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—2 to 15 percent

Bw horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or gravelly sandy loam

Content of rock fragments—2 to 25 percent

BC horizon:

Hue—7.5YR or 5YR

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam, loamy sand, or gravelly sandy loam

Content of rock fragments—2 to 25 percent

Cd horizon:

Hue—7.5YR or 5YR

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam, loamy sand, or gravelly sandy loam

Content of rock fragments—2 to 25 percent

Warba Series*Depth class:* Very deep*Drainage class:* Well drained

Permeability: Upper part—moderately rapid; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 25 percent

Taxonomic class: Fine-loamy, mixed Glossic Eutroboralfs

Typical Pedon

Warba very fine sandy loam, 3 to 8 percent slopes, 990 feet north and 1,270 feet west of the southeast corner of sec. 31, T. 145 N., R. 30 W.

Oi—2 inches to 0; black (5YR 2/1) forest litter derived from leaves, twigs, and roots.

A—0 to 1 inch; very dark gray (10YR 3/1) very fine sandy loam, gray (10YR 5/1) dry; weak very fine granular structure; very friable; many roots; about 4 percent gravel; moderately acid; abrupt smooth boundary.

E1—1 to 6 inches; grayish brown (10YR 5/2) very fine sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; very friable; many roots; few vesicular pores; about 5 percent gravel; strongly acid; clear wavy boundary.

E2—6 to 11 inches; light brownish gray (10YR 6/2) very fine sandy loam, light gray (10YR 7/1) dry; moderate thin platy structure; friable; many roots; common vesicular pores; about 3 percent gravel; moderately acid; abrupt wavy boundary.

E/B—11 to 15 inches; about 70 percent light brownish gray (10YR 6/2) very fine sandy loam (E); massive; friable; about 30 percent dark brown (10YR 4/3) clay loam (Bt); weak coarse subangular blocky structure; firm; many roots; few pores; about 3 percent gravel; moderately acid; clear wavy boundary.

B/E—15 to 18 inches; about 70 percent dark brown (10YR 4/3) clay loam (Bt); moderate medium and coarse subangular blocky structure; firm; about 30 percent light brownish gray (10YR 6/2) loamy very fine sand (E); massive; friable; few roots; few pores; about 3 percent gravel; moderately acid; clear wavy boundary.

Bt1—18 to 24 inches; light olive brown (2.5Y 5/4) clay loam; strong medium prismatic structure parting to strong medium and coarse angular blocky; firm; few roots; few pores; many distinct dark brown (10YR 4/3) clay films on faces of peds and lining pores; few thin interfingerings and ped coatings of E material; about 3 percent gravel; moderately acid; clear wavy boundary.

Bt2—24 to 29 inches; light olive brown (2.5Y 5/4) clay

loam; moderate coarse prismatic structure parting to moderate coarse and medium angular blocky; firm; few roots; few pores; many distinct dark brown (10YR 4/3) clay films on faces of peds and lining pores; few clean sand grains on some vertical faces of peds; about 4 percent gravel; moderately acid; clear wavy boundary.

Bt3—29 to 37 inches; light olive brown (2.5Y 5/4) clay loam; weak very coarse prismatic structure; friable; few roots; few pores; common distinct dark brown (10YR 4/3) clay films on faces of peds; very few fine soft manganese nodules; about 4 percent gravel; moderately acid; clear wavy boundary.

C1—37 to 42 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish red (5YR 5/6) mottles; massive; friable; few roots; few pores; about 5 percent gravel; neutral; clear wavy boundary.

C2—42 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine prominent yellowish red (5YR 5/6) mottles; massive; friable; few roots; few pores; about 6 percent gravel; neutral; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 34 to 70 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—very fine sandy loam or silt loam

Content of rock fragments—0 to 5 percent

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 or 3

Texture—fine sandy loam, very fine sandy loam, loam, or silt loam

Content of rock fragments—0 to 5 percent

E/B or B/E horizon:

Colors—similar to those of the E and B horizons

Textures—similar to those of the E and B horizons

Bt horizon:

Hue—10YR

Value—4 to 6

Chroma—3 or 4

Texture—clay loam, sandy clay loam, or loam

Content of rock fragments—2 to 12 percent

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—clay loam, sandy clay loam, or loam

Content of rock fragments—2 to 12 percent

Watab Series*Depth class:* Very deep*Drainage class:* Poorly drained*Permeability:* Upper part—rapid; lower part—very slow*Landform:* Drumlins and ground moraines*Parent material:* Sandy mantle and the underlying dense till*Slope range:* 0 to 2 percent*Taxonomic class:* Loamy, mixed, frigid Arenic Epiaqualfs**Typical Pedon**

Watab loamy sand, 20 feet west and 50 feet south of the northeast corner of sec. 16, T. 139 N., R. 28 W.

A—0 to 5 inches; dark brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure parting to weak fine granular; very friable; many fine roots; about 1 percent gravel; strongly acid; abrupt smooth boundary.

E1—5 to 12 inches; dark grayish brown (10YR 4/2) loamy sand; few fine distinct dark yellowish brown (10YR 4/6) mottles; weak very fine subangular blocky structure; very friable; many fine roots; about 1 percent gravel; strongly acid; clear smooth boundary.

E2—12 to 21 inches; dark brown (10YR 4/3) loamy sand; few fine prominent strong brown (7.5YR 4/6) and few fine faint grayish brown (10YR 5/2) mottles; weak very fine and fine subangular blocky structure; very friable; many fine roots; about 1 percent gravel; strongly acid; clear smooth boundary.

Bw—21 to 30 inches; yellowish brown (10YR 5/6) loamy sand; common medium distinct strong brown (7.5YR 4/6) and common medium prominent light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; many very fine roots; about 5 percent gravel; moderately acid; clear smooth boundary.

2Bt—30 to 38 inches; strong brown (7.5YR 5/4) fine sandy loam; many medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common prominent grayish brown (10YR 5/2) clay films in channels; common prominent light brownish gray (10YR 6/2) silt coatings on faces of peds; about 13 percent gravel; strongly acid; abrupt smooth boundary.

2BC—38 to 41 inches; strong brown (7.5YR 4/4) sandy loam; many medium prominent light brownish gray (10YR 6/2) and common fine distinct reddish yellow (7.5YR 6/6) mottles; moderate medium subangular blocky structure; firm; about 12 percent gravel; moderately acid; clear smooth boundary.

2Cd—41 to 60 inches; strong brown (7.5YR 4/4) sandy loam; many medium prominent light brownish gray (10YR 6/2) and common fine distinct reddish yellow (7.5YR 6/6) mottles; massive; very firm; common very dark grayish brown (10YR 3/2) organic coatings in pores; about 12 percent gravel; moderately acid.

Range in Characteristics*Depth to dense till:* 30 to 55 inches*A or Ap horizon:*

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Content of rock fragments—0 to 2 percent

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 or 3

Texture—loamy fine sand, loamy sand, fine sand, or sand

Content of rock fragments—0 to 2 percent

Bw horizon:

Hue—10YR

Value—4 or 5

Chroma—3 to 6

Texture—loamy fine sand or loamy sand

Content of rock fragments—0 to 8 percent

2Bt horizon:

Hue—5YR or 7.5YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or gravelly sandy loam

Content of rock fragments—8 to 20 percent

2BC horizon:

Colors—similar to those of the 2Cd horizon

Textures—similar to those of the 2Cd horizon

2Cd horizon:

Hue—7.5YR or 5YR

Value—4 or 5

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or gravelly sandy loam

Content of rock fragments—8 to 20 percent

Zimmerman Series*Depth class:* Very deep*Drainage class:* Excessively drained*Permeability:* Rapid

Landform: Outwash plains

Parent material: Sandy outwash or eolian sediments

Slope range: 1 to 8 percent

Taxonomic class: Mixed, frigid Argic Udipsamments

Typical Pedon

Zimmerman fine sand, 1 to 8 percent slopes, 1,000 feet south and 1,550 feet west of the northeast corner of sec. 33, T. 145 N., R. 31 W.

Oi—1 inch to 0; forest litter derived from needles, twigs, and roots; abrupt smooth boundary.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; clear smooth boundary.

E1—1 to 4 inches; dark gray (10YR 4/1) fine sand; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; clear smooth boundary.

E2—4 to 9 inches; dark yellowish brown (10YR 4/4) fine sand; weak fine subangular blocky structure; very friable; many fine roots; strongly acid; clear smooth boundary.

E3—9 to 16 inches; light yellowish brown (10YR 6/4) fine sand; single grain; loose; moderately acid; clear smooth boundary.

E4—16 to 26 inches; yellowish brown (10YR 5/4) fine sand; single grain; loose; moderately acid; clear smooth boundary.

E5—26 to 41 inches; pale brown (10YR 6/3) fine sand; single grain; loose; moderately acid; clear smooth boundary.

E&Bt—41 to 60 inches; pale brown (10YR 6/3) fine sand (E) and thin bands of brown (7.5YR 4/4) loamy fine sand (Bt); single grain; friable; moderately acid.

Range in Characteristics

Content of rock fragments: 0 to 5 percent

Other features: A C horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sand or loamy fine sand

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 to 4

Texture—fine sand or loamy fine sand

Bt horizon:

Thickness— $\frac{1}{16}$ inch to 2 inches; cumulative thickness of less than 6 inches

Hue—5YR, 7.5YR, or 10YR

Value—3 to 5

Chroma—2 to 6

Texture—fine sand, loamy fine sand, very fine sand, loamy very fine sand, or fine sandy loam

Taxonomic Units in the Chippewa National Forest

Aeric Glossaqualfs

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate to slow

Landform: Moraines and lake plains

Parent material: Till or lacustrine sediments

Slope range: 0 to 3 percent

Taxonomic class: Aeric Glossaqualfs

Sample Pedon

Location: Section 31, T. 149 N., R. 27 W.

Oe—1 inch to 0; a mixture of slightly decomposed and partly decomposed plant material.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; many roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 5 inches; gray (10YR 5/1) fine sandy loam, light gray (10YR 6/1) dry; moderate medium subangular blocky structure; friable; many roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw1—5 to 9 inches; brown (10YR 5/3) fine sandy loam; moderate medium subangular blocky structure; friable; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw2—9 to 13 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium prominent strong brown (7.5YR 5/6) and common fine faint yellowish brown (10YR 5/6) mottles; strong medium subangular blocky structure; friable; few roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E/B—13 to 24 inches; about 60 percent gray (10YR 6/1) fine sandy loam (E) and 40 percent dark brown (10YR 4/3) clay loam (Bt); common medium prominent strong brown (7.5YR 5/8) and common medium distinct brown (10YR 5/3) mottles; strong medium subangular blocky structure; firm; few roots; few distinct dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; clear smooth boundary.

Btg—24 to 30 inches; dark yellowish brown (10YR 4/4)

clay loam; common medium distinct grayish brown (10YR 5/2) and common fine prominent strong brown (7.5YR 5/8) mottles; strong medium subangular blocky structure; firm; very few roots; many faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; moderately acid; clear smooth boundary.

BC—30 to 35 inches; dark yellowish brown (10YR 4/6) clay loam; common medium prominent yellowish red (5YR 5/8) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; very few roots; about 2 percent gravel; neutral; clear smooth boundary.

C—35 to 60 inches; dark brown (10YR 3/3) silty clay loam; common medium distinct yellowish brown (10YR 5/4) and common fine distinct grayish brown (10YR 5/2) mottles; massive with moderate medium subangular blocky soil fragments; firm; about 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Content of gravel: 1 to 15 percent

Other features: A B/E horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam, silt loam, sandy loam, silty clay loam, loamy sand, loamy fine sand, or very fine sandy loam

E horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—1 to 3

Texture—fine sandy loam, silt loam, sandy loam, silty clay loam, loamy sand, loamy fine sand, or very fine sandy loam

Bw horizon (if it occurs):

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—3 to 5

Texture—fine sandy loam, silt loam, sandy loam, silty clay loam, loamy sand, loamy fine sand, or very fine sandy loam

E/B horizon:

Colors—similar to those of the B and E horizons

Textures—similar to those of the B and E horizons

Btg horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—4 or 5

Chroma—2 to 4

Texture—clay loam, loam, sandy clay loam, fine sandy loam, sandy loam, silty clay loam, or silt loam

BC horizon (if it occurs):

Hue—2.5Y, 10YR, or 7.5YR

Value—3 to 6

Chroma—2 to 6

Texture—clay loam, loam, sandy clay loam, fine sandy loam, sandy loam, silty clay loam, silt loam, loamy sand, or loamy fine sand

C or Cg horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—3 to 6

Chroma—2 to 4

Texture—clay loam, loam, sandy clay loam, fine sandy loam, sandy loam, silty clay loam, silt loam, loamy sand, or loamy fine sand

Alfic Udipsamments

Drainage class: Excessively drained

Permeability: Rapid

Landform: Outwash plains, lake plains, and moraines

Parent material: Sandy sediments

Slope range: 0 to 8 percent

Taxonomic class: Alfic Udipsamments

Sample Pedon

Location: Section 9, T. 147 N., R. 27 W.

Oi—2 inches to 0; partially decomposed forest litter.

A—0 to 1 inch; black (10YR 2/1) loamy sand; weak fine granular structure; very friable; many roots; strongly acid; abrupt smooth boundary.

E—1 to 3 inches; grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) loamy sand; weak coarse subangular blocky structure parting to weak very fine granular; very friable; many roots; strongly acid; abrupt wavy boundary.

Bw1—3 to 7 inches; yellowish brown (10YR 5/4) loamy fine sand; weak very fine granular structure; very friable; many roots; strongly acid; clear wavy boundary.

Bw2—7 to 17 inches; brown (10YR 5/3) fine sand; single grain; loose; common roots; moderately acid; gradual wavy boundary.

E'—17 to 26 inches; light brownish gray (10YR 6/2) fine sand; single grain; loose; common roots; moderately acid; clear wavy boundary.

E&Bt—26 to 58 inches; light brownish gray (10YR 6/2) and brown (10YR 5/3) fine sand and sand; single grain (E'); loose; dark brown (7.5YR 4/4), yellowish brown (10YR 5/4), and brown (10YR 5/3) fine sandy loam and loamy sand (Bt); massive; firm; many thin

clay bridges between sand grains; slightly acid;
clear wavy boundary.

C—58 to 60 inches; light brownish gray (10YR 6/2 and 2.5Y 6/2) sand; single grain; loose; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 48 to more than 60 inches

Content of gravel: 0 to 15 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand, sand, loamy fine sand, or fine sand

E or E' horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

Texture—sand, loamy sand, fine sand, or loamy fine sand

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—sand, loamy sand, fine sand, loamy fine sand, or coarse sand

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, loamy sand, or loamy fine sand

Thickness—less than 6 inches (total accumulation)

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—sand, fine sand, coarse sand

Aqualfs

Drainage class: Somewhat poorly drained and poorly drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate or moderately slow

Landform: Moraines and lake plains

Parent material: Till or lacustrine sediments

Slope range: 0 to 2 percent

Taxonomic class: Aqualfs

Sample Pedon

Location: Section 13, T. 148 N., R. 27 W.

Oe—1 inch to 0; a mixture of slightly decomposed and partly decomposed plant material.

A—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; many roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E1—2 to 6 inches; light gray (10YR 7/1) loamy fine sand; moderate medium granular structure; friable; many roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E2—6 to 12 inches; pale brown (10YR 6/3) loamy fine sand; common medium prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; friable; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Bw—12 to 17 inches; dark yellowish brown (10YR 4/4) fine sandy loam; common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; few roots; about 2 percent gravel; strongly acid; clear wavy boundary.

Btg—17 to 31 inches; dark grayish brown (10YR 4/2) clay loam; common distinct pale brown (10YR 6/3) mottles; moderate medium subangular blocky structure; firm; many faint dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 2 percent gravel; slightly acid; gradual smooth boundary.

BCg—31 to 37 inches; brown (10YR 5/3) clay loam; many prominent medium yellowish brown (10YR 5/8) and common fine faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; about 2 percent gravel; slightly acid; gradual smooth boundary.

Cg—37 to 60 inches; light brownish gray (10YR 6/2) clay loam; common medium prominent strong brown (7.5YR 5/6) and few fine distinct dark gray (10YR 4/1) mottles; massive with weak medium platy soil fragments; firm; about 2 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Content of gravel: 1 to 15 percent

Other features: A B/E or E/B horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand or fine sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—1 to 3

Texture—silt loam, very fine sandy loam, loamy fine sand, loamy very fine sand, fine sandy loam, sandy loam, loam, or loamy sand

Bw horizon (if it occurs):

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—3 to 5

Texture—silt loam, very fine sandy loam, loamy fine sand, loamy very fine sand, fine sandy loam, sandy loam, loam, or loamy sand

B/E horizon (if it occurs):

Colors—similar to those of the B and E horizons

Textures—similar to those of the B and E horizons

E/B horizon (if it occurs):

Colors—similar to those of the B and E horizons

Textures—similar to those of the B and E horizons

Btg horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam, silt loam, silty clay loam, loam, sandy loam, fine sandy loam, sandy clay loam, silty clay, clay, or sandy clay

BC horizon (if it occurs):

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—clay loam, silt loam, silty clay loam, loam, sandy loam, fine sandy loam, sandy clay loam, silty clay, clay, or sandy clay

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—clay loam, silt loam, silty clay loam, loam, sandy loam, fine sandy loam, sandy clay loam, silty clay, clay, or sandy clay

blocky structure; very friable; many fine roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 4 inches; grayish brown (10YR 5/2) fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

Bw—4 to 8 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; common coarse roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

Bt1—8 to 16 inches; light yellowish brown (10YR 5/4) sandy loam; many medium prominent yellowish red (5YR 5/8) and light gray (10YR 7/1) mottles; weak fine subangular blocky structure; friable; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt2—16 to 26 inches; yellowish brown (10YR 5/4) loam; many medium prominent yellowish red (5YR 5/8) and light gray (10YR 7/1) mottles; weak medium subangular blocky structure; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few prominent light gray silt coatings on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt3—26 to 47 inches; yellowish brown (10YR 5/4) loam; common medium prominent strong brown (7.5YR 5/8) and light gray (10YR 7/1) mottles; moderate medium subangular blocky structure; firm; common prominent light brownish gray (2.5Y 6/2) clay films on faces of peds; about 2 percent gravel; slightly acid; clear smooth boundary.

C—47 to 60 inches; yellowish brown (10YR 5/6) sandy loam; common fine prominent yellowish red (5YR 5/8) and light gray (5Y 7/1) mottles; massive with weak fine subangular blocky soil fragments; firm; about 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 15 to more than 60 inches

Content of gravel: 0 to 10 percent

Other features: A BC horizon in some pedons

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam, sandy loam, silt loam, very fine sandy loam, silty clay loam, loam, clay loam, loamy fine sand, loamy sand, or loamy very fine sand

E horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Aquic Eutroboralfs

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderate to slow

Landform: Moraines, lake plains, and outwash plains

Parent material: Till or lacustrine sediments

Slope range: 0 to 8 percent

Taxonomic class: Aquic Eutroboralfs

Sample Pedon

Location: NW¼NE¼ sec. 30, T. 142 N., R. 30 W.

A—0 to 2 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine subangular

Chroma—2 or 3

Texture—fine sandy loam, sandy loam, silt loam, very fine sandy loam, silty clay loam, loam, clay loam, or loamy very fine sand

Bw horizon (if it occurs):

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, silt loam, very fine sandy loam, silty clay loam, loamy sand, loamy fine sand, loam, sand, or fine sand

Bt horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, silt loam, very fine sandy loam, silty clay loam, loam, sandy clay loam, clay, silty clay, clay loam, or sandy clay

C or Cg horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—fine sandy loam, sandy loam, silt loam, very fine sandy loam, loam, sandy clay loam, clay loam, silty clay loam, sandy clay, or loamy very fine sand

Arenic Eutroboralfs

Drainage class: Well drained

Permeability: Upper part—rapid; lower part—moderately slow or slow

Landform: Moraines

Parent material: Sandy sediments over till

Slope range: 0 to 8 percent

Taxonomic class: Arenic Eutroboralfs

Sample Pedon

Location: Section 30, T. 145 N., R. 31 W.

Oi—2 inches to 0; slightly decomposed forest litter.

A—0 to 1 inch; very dark gray (10YR 3/1) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine granular structure; very friable; many fine roots; about 2 percent gravel; moderately acid; abrupt discontinuous boundary.

E—1 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; very friable; common fine roots; moderately acid; clear wavy boundary.

Bw1—6 to 10 inches; dark brown (10YR 4/3) loamy fine sand; single grain; loose; very friable; common

roots; about 2 percent gravel; moderately acid; clear smooth boundary.

Bw2—10 to 20 inches; brown (10YR 5/3) loamy fine sand; single grain; loose; common fine roots; about 5 percent gravel; moderately acid; clear smooth boundary.

Bw3—20 to 30 inches; yellowish brown (10YR 5/4 and 5/6) sand; single grain; loose; few fine roots; slightly acid; abrupt wavy boundary.

2Bt—30 to 36 inches; dark yellowish brown (10YR 3/4) sandy loam; weak medium subangular blocky structure; friable; few fine roots; few distinct yellowish brown (10YR 5/4) clay films on faces of peds and in root channels; about 2 percent gravel; neutral; abrupt wavy boundary.

2C—36 to 60 inches; light olive brown (2.5Y 5/4 and 5/3) silty clay loam; massive with weak medium subangular blocky soil fragments; friable; few very fine roots; about 2 percent gravel; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—loamy fine sand, loamy sand, sand, or fine sand

Content of gravel—0 to 5 percent

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 or 3

Texture—loamy fine sand, loamy sand, sand, fine sand, coarse sand, or loamy coarse sand

Content of gravel—0 to 5 percent

Bw horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 6

Texture—loamy fine sand, fine sand, loamy sand, sand, coarse sand, or loamy coarse sand

Content of gravel—0 to 5 percent

2Bt horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—sandy loam, clay loam, silty clay loam, loam, fine sandy loam, clay, or silty clay

Content of gravel—1 to 15 percent

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6
 Chroma—3 or 4
 Texture—sandy loam, clay loam, silty clay loam,
 loam, or fine sandy loam
 Content of gravel—1 to 15 percent

Dystric Eutrochrepts

Drainage class: Well drained
Permeability: Upper part—moderate or moderately rapid; lower part—rapid
Landform: Moraines
Parent material: Loamy mantle and the underlying sandy sediments
Slope range: 0 to 10 percent
Taxonomic class: Dystric Eutrochrepts

Sample Pedon

Location: Section 12, T. 142 N., R. 29 W.

Oe—2 inches to 0; partially decomposed forest litter.
 A—0 to 3 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate coarse subangular blocky structure; very friable; many fine roots; neutral; abrupt smooth boundary.
 E1—3 to 13 inches; dark brown (10YR 4/3) loam, light brownish gray (10YR 6/2) dry; moderate coarse subangular blocky structure; very friable; many fine roots; slightly acid; clear smooth boundary.
 E2—13 to 20 inches; brown (10YR 5/3) loam; weak thick platy structure; friable; common fine roots; moderately acid; clear smooth boundary.
 Bw—20 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate coarse subangular blocky structure; friable; common fine roots; about 5 percent gravel and 3 percent cobbles; moderately acid; clear smooth boundary.
 2BC—33 to 46 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.
 2C—46 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand; loose; friable; slightly acid.

Range in Characteristics

Depth to carbonates: More than 65 inches
Content of rock fragments: 0 to 10 percent gravel and 0 to 5 percent cobbles
A horizon:
 Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—loam, fine sandy loam, sandy loam, silt loam, or very fine sandy loam

E horizon:

Hue—10YR, 2.5Y, or 7.5YR
 Value—4 to 6
 Chroma—2 or 3
 Texture—loam, fine sandy loam, sandy loam, silt loam, or very fine sandy loam

Bw horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—loam, fine sandy loam, sandy loam, silt loam, or very fine sandy loam

2BC horizon (if it occurs):

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—loamy fine sand, fine sand, loamy sand, or sand

2C horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—loamy fine sand, fine sand, loamy sand, or sand

Eutroboralfs

Drainage class: Well drained or moderately well drained
Permeability: Moderate to slow
Landform: Lake plains and moraines
Parent material: Loamy till or lacustrine sediments
Slope range: 0 to 8 percent
Taxonomic class: Eutroboralfs

Sample Pedon

Location: Section 23, T. 144 N., R. 26 W.

A—0 to 2 inches; black (10YR 2/1) fine sandy loam; moderate very fine granular structure; friable; many fine and very fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.
 E—2 to 13 inches; grayish brown (10YR 5/2) loamy fine sand; weak fine subangular blocky structure; friable; many fine roots; about 2 percent gravel; moderately acid; clear smooth boundary.
 Bt—13 to 28 inches; dark yellowish brown (10YR 4/4) loam; moderate fine subangular blocky structure; friable; few roots; common faint dark brown (10YR 4/3) clay films on faces of peds; about 5 percent gravel; moderately acid; gradual smooth boundary.
 C—28 to 60 inches; brown (10YR 5/3) sandy loam; few fine prominent yellowish brown (10YR 5/8) mottles; massive with weak fine subangular blocky soil fragments; friable; few roots; about 5 percent

gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches

Content of gravel: 0 to 10 percent

Other features: A B/E or E/B horizon in some pedons

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam, very fine sandy loam, silt loam, sandy loam, loamy sand, loamy fine sand, or silty clay loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

Texture—fine sandy loam, very fine sandy loam, silt loam, sandy loam, loamy sand, loamy fine sand, or silty clay loam

B/E or E/B horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—3 to 6

Chroma—3 to 6

Texture—loam, clay loam, fine sandy loam, sandy loam, silt loam, clay, silty clay loam, silty clay, or very fine sandy loam

C horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—loam, clay loam, fine sandy loam, sandy loam, silt loam, clay, silty clay loam, silty clay, very fine sandy loam, sand, loamy sand, or loamy fine sand

Glossaqualfs

Drainage class: Somewhat poorly drained or poorly drained

Permeability: Upper part—rapid to moderate; lower part—moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent slopes

Taxonomic class: Glossaqualfs

Sample Pedon

Location: Section 15, T. 141 N., R. 26 W.

A—0 to 3 inches; very dark gray (10YR 3/1) loam;

moderate very fine granular structure; friable; many fine and very fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Eg—3 to 9 inches; light brownish gray (10YR 6/2) fine sandy loam; common fine prominent yellowish brown (10YR 5/8) mottles; weak thin platy structure; friable; common fine roots; about 3 percent gravel; moderately acid; clear smooth boundary.

E/B—9 to 28 inches; about 60 percent grayish brown (10YR 5/2) fine sandy loam (E); tongued into and surrounding about 40 percent dark grayish brown (10YR 4/2) clay loam (Bt); common fine faint light brownish gray (10YR 6/2) and strong brown (7.5YR 5/8) mottles; friable; about 5 percent gravel; slightly acid; gradual smooth boundary.

Btg—28 to 36 inches; light brownish gray (10YR 6/2) loam; common fine distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; common distinct dark grayish brown (10YR 4/2) clay films on faces of peds; about 5 percent gravel; neutral; gradual smooth boundary.

Cg—36 to 60 inches; light brownish gray (10YR 6/2) sandy loam; common fine distinct dark grayish brown (10YR 4/2) and brown (10YR 4/3) mottles; massive; about 8 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Content of gravel: 1 to 15 percent

Other features: A B/E horizon in some pedons

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam, fine sandy loam, silt loam, silty clay loam, sandy loam, loamy sand, loamy fine sand, or loamy very fine sand

E or Eg horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—1 to 3

Texture—loam, fine sandy loam, silt loam, silty clay loam, sandy loam, loamy sand, loamy fine sand, or loamy very fine sand

E/B horizon or B/E horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Btg or Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—1 to 3

Texture—loam, sandy loam, clay loam, fine sandy loam, very fine sandy loam, silt loam, or silty clay loam

Cg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 to 3

Texture—loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, silt loam, very fine sandy loam, or silty clay loam

Glossic Eutroboralfs

Drainage class: Well drained

Permeability: Moderately rapid to moderately slow

Landform: Moraines

Parent material: Till

Slope range: 8 to 20 percent

Taxonomic class: Glossic Eutroboralfs

Sample Pedon

Location: Section 19, T. 142 N., R. 25 W.

A—0 to 1 inch; very dark gray (10YR 3/1) very fine sandy loam; weak very fine granular structure; friable; many fine roots; about 3 percent gravel; strongly acid; abrupt clear boundary.

E—1 to 6 inches; pale brown (10YR 6/3) very fine sandy loam; weak thin platy structure; friable; common fine roots; about 3 percent gravel; strongly acid; clear smooth boundary.

Bw—6 to 18 inches; yellowish brown (10YR 5/4) very fine sandy loam; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; moderately acid; clear wavy boundary.

E/B—18 to 23 inches; about 60 percent pale brown (10YR 6/3) very fine sandy loam (E); tongued into and surrounding about 40 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); moderate fine subangular blocky structure; friable; few fine roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

B/E—23 to 26 inches; about 60 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); tongued into and surrounding about 40 percent pale brown (10YR 6/3) very fine sandy loam (E); moderate fine subangular blocky structure; friable; few roots; about 3 percent gravel; moderately acid; clear smooth boundary.

Bt—26 to 48 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate fine subangular blocky structure; friable; common distinct dark brown (7.5YR 3/4) clay films on faces of peds; about 5

percent gravel; slightly acid; clear smooth boundary.
BC—48 to 56 inches; brown (10YR 5/3) sandy loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; friable; about 5 percent gravel; neutral; gradual smooth boundary.

C—56 to 60 inches; dark brown (7.5YR 4/4) sandy loam; massive; friable; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Content of gravel: 1 to 15 percent

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 or 2

Texture—very fine sandy loam, silt loam, fine sandy loam, or sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 or 3

Texture—very fine sandy loam, silt loam, fine sandy loam, or sandy loam

Bw horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—very fine sandy loam, silt loam, fine sandy loam, or sandy loam

E/B and B/E horizons:

Colors—similar to those of the B and E horizons

Textures—similar to those of the B and E horizons

Bt horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, loam, clay loam, or silty clay loam

BC horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, loam, clay loam, loamy sand, or loamy fine sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, loam, clay loam, loamy sand, or loamy fine sand

Histosols

Drainage class: Very poorly drained

Permeability: Moderately slow to rapid

Landform: Outwash plains, lake plains, and moraines

Parent material: Organic materials

Slope range: 0 to 2 percent

Taxonomic class: Histosols

Sample Pedon

Location: Section 19, T. 148 N., R. 30 W.

Oe1—0 to 17 inches; mucky peat, black (10YR 2/1) broken face, rubbed, and pressed; about 55 percent fiber, 20 percent rubbed; weak medium subangular blocky structure; very strongly acid; abrupt smooth boundary.

Oe2—17 to 32 inches; mucky peat, very dark gray (10YR 3/1) broken face, rubbed, and pressed; about 30 percent fiber, 15 percent rubbed; weak medium subangular blocky structure; moderately acid; abrupt smooth boundary.

Oa1—32 to 45 inches; muck, dark brown (7.5YR 4/2) broken face, rubbed, and pressed; about 25 percent fiber, 5 percent rubbed; weak medium subangular blocky structure; neutral; abrupt smooth boundary.

Oa2—45 to 60 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 15 percent fiber, 1 percent rubbed; weak medium subangular blocky structure; neutral.

Range in Characteristics

Organic material:

Kind—muck, mucky peat, or peat

Thickness—16 to more than 51 inches

Content of fibers—15 to 85 percent unrubbed; 0 to 50 percent rubbed

Reaction—extremely acid to moderately alkaline

Hue—7.5YR, 10YR, or neutral

Value—2 to 5

Chroma—0 to 3

Humaquepts

Drainage class: Poorly drained and very poorly drained

Permeability: Rapid to moderate

Landform: Outwash plains

Parent material: Loamy or sandy sediments

Slope range: 0 to 2 percent

Taxonomic class: Humaquepts

Sample Pedon

Location: Section 14, T. 146 N., R. 31 W.

Oa—4 inches to 0; dark reddish brown (5YR 3/2) muck; about 30 percent fiber, 5 percent rubbed; weak

medium platy structure; very friable; common fine roots; strongly acid; abrupt smooth boundary.

A—0 to 4 inches; dark gray (N 4/0) and gray (5Y 5/1) fine sandy loam; weak fine granular structure; very friable; common fine roots; moderately acid; abrupt smooth boundary.

Bg1—4 to 10 inches; light brownish gray (2.5Y 6/2) loamy fine sand; weak fine subangular blocky structure; very friable; few fine roots; moderately acid; clear smooth boundary.

Bg2—10 to 29 inches; light olive gray (5Y 6/2) fine sand; common fine prominent strong brown (7.5YR 5/8) mottles; weak very fine subangular blocky structure; very friable; about 5 percent gravel; slightly acid; clear smooth boundary.

Cg—29 to 60 inches; gray (5Y 6/1) fine sandy loam; common fine prominent strong brown (7.5YR 5/8) mottles; massive; friable; about 5 percent gravel; neutral.

Range in Characteristics

Thickness of the organic mat: 3 to 12 inches

Depth to carbonates: 24 to more than 60 inches

Content of gravel: 0 to 15 percent

O horizon (if it occurs):

Hue—5YR, 7.5YR, or 10YR

Value—1 to 4

Chroma—1 to 3

Texture—muck, mucky peat, or peat

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 to 5

Chroma—0 to 2

Texture—fine sandy loam, very fine sandy loam, sandy loam, loamy sand, loamy fine sand, silt loam, loam, or sand

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, very fine sandy loam, sandy loam, loamy sand, loamy fine sand, silt loam, loam, or sand

Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—fine sandy loam, very fine sandy loam, sandy loam, loamy sand, loamy fine sand, silt loam, loam, clay loam, silty clay loam, or sand

Mollic Fluvaquents

Drainage class: Poorly drained or very poorly drained

Permeability: Rapid to moderately slow

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic class: Mollic Fluvaquents

Sample Pedon

Location: Northwest corner of sec. 11, T. 144 N., R. 26 W.

A—0 to 15 inches; black (10YR 2/1) fine sandy loam; weak very fine granular structure; friable; few roots; slightly acid; clear smooth boundary.

Cg—15 to 60 inches; grayish brown (10YR 5/2), stratified loamy fine sand, loamy sand, and silt loam; many medium yellowish brown (10YR 5/8) mottles; massive; neutral.

Range in Characteristics

Content of gravel: 0 to 10 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam, silt loam, fine sandy loam, loamy fine sand, fine sand, sand, loamy sand, or loam

Cg horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, silt loam, fine sandy loam, loamy fine sand, fine sand, sand, loamy sand, silty clay loam, clay loam, or loam

Psammentic Eutroboralfs

Drainage class: Well drained and somewhat excessively drained

Permeability: Rapid

Landform: Outwash plains

Parent material: Sandy sediments

Slope range: 0 to 20 percent

Taxonomic class: Sandy, mixed Psammentic Eutroboralfs

Sample Pedon

Location: Section 16, T. 147 N., R. 27 W.

Oe—2 inches to 0; moderately decomposed forest litter.

E—0 to 2 inches; very dark grayish brown (10YR 3/2) loamy sand; weak medium platy structure; very friable; many very fine and fine roots; about 1 percent gravel; moderately acid; abrupt smooth boundary.

Bw1—2 to 12 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; many very fine and fine roots; about 1 percent gravel; moderately acid; clear smooth boundary.

Bw2—12 to 26 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common fine roots; about 5 percent gravel and 3 percent cobbles; moderately acid; clear wavy boundary.

Bt—26 to 34 inches; dark yellowish brown (10YR 4/4) gravelly loamy coarse sand; weak coarse subangular blocky structure parting to single grain; friable; few roots; few distinct dark brown (7.5YR 4/4) clay films between and on sand grains; about 10 percent gravel and 10 percent cobbles; strongly acid; clear wavy boundary.

BC—34 to 48 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 4 percent gravel and 2 percent cobbles; moderately acid; gradual smooth boundary.

C1—48 to 58 inches; pale brown (10YR 6/3) coarse sand that has a very thin band of yellowish brown (10YR 5/4) loamy sand; single grain; loose; about 2 percent gravel; slightly acid; gradual smooth boundary.

C2—58 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; about 2 percent gravel; neutral.

Range in Characteristics

Ap or A horizon (if it occurs):

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand, loamy fine sand, sand, or fine sand

Content of gravel and cobbles—0 to 15 percent

E horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—2 or 3

Texture—loamy sand, loamy fine sand, sand, or fine sand

Content of gravel and cobbles—0 to 15 percent

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 5

Texture—loamy sand, loamy fine sand, sand, fine sand, coarse sand, loamy coarse sand, or the gravelly and cobbly analogs of these textures

Content of gravel and cobbles—2 to 25 percent

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5
 Chroma—3 to 6
 Texture—loamy sand, loamy fine sand, loamy coarse sand, or the gravelly and cobbly analogs of these textures
 Content of gravel and cobbles—2 to 25 percent

BC horizon (if it occurs):

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—3 to 6
 Texture—sand, coarse sand, fine sand, or the gravelly and cobbly analogs of these textures
 Content of gravel and cobbles—2 to 25 percent

C horizon:

Hue—10YR or 7.5YR
 Value—4 to 6
 Chroma—2 to 4
 Texture—sand, coarse sand, fine sand, or the gravelly analogs of these textures
 Content of gravel and cobbles—2 to 25 percent

Typic Borochemists

Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid
Landform: Outwash plains, lake plains, and moraines
Parent material: Moderately decomposed organic materials
Slope range: 0 to 2 percent
Taxonomic class: Typic Borochemists

Sample Pedon

Location: Section 5, T. 144 N., R. 30 W.

- Oe1—0 to 4 inches; dark reddish brown (5YR 2/2) mucky peat; about 45 percent fiber, 20 percent rubbed; weak thick platy structure; very friable; very strongly acid; abrupt smooth boundary.
- Oe2—4 to 8 inches; dark reddish brown (5YR 3/2) mucky peat, dark brown (7.5YR 3/4) pressed; about 65 percent fiber, 25 percent rubbed; weak thick platy structure; very friable; extremely acid; abrupt smooth boundary.
- Oe3—8 to 10 inches; dark reddish brown (5YR 2/2) mucky peat; about 45 percent fiber, 20 percent rubbed; weak thick platy structure; very friable; extremely acid; clear smooth boundary.
- Oe4—10 to 29 inches; dark reddish brown (5YR 2/2) mucky peat; about 40 percent fiber, 15 percent rubbed; massive; very friable; about 15 percent woody fragments larger than 2 millimeters in size; very strongly acid; clear smooth boundary.
- Oe5—29 to 60 inches; dark reddish brown (5YR 3/2 and 3/3) mucky peat; about 60 percent fiber, 15

percent rubbed; massive; very friable; very strongly acid.

Range in Characteristics

Organic material:

Kind—mucky peat
 Thickness—16 to more than 51 inches
 Content of fibers—20 to 80 percent unrubbed; 15 to 45 percent rubbed
 Content of woody fragments larger than 2 millimeters in size—0 to 15 percent
 Reaction—extremely acid to moderately alkaline
 Hue—5YR, 7.5YR, or 10YR
 Value—2 to 4
 Chroma—2 or 3

Typic Borosaprists

Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Outwash plains, moraines, lake plains, and flood plains
Parent material: Moderately decomposed organic materials
Slope range: 0 to 2 percent
Taxonomic class: Typic Borosaprists

Sample Pedon

Location: Section 2, T. 149 N., R. 31 W.

- Oa1—0 to 20 inches; muck, black (10YR 2/1) broken face, rubbed, and pressed; about 35 percent fiber, 5 percent rubbed; weak fine subangular blocky structure; strongly acid; clear smooth boundary.
- Oa2—20 to 42 inches; muck, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 30 percent fiber, 5 percent rubbed; massive; slightly acid; gradual smooth boundary.
- Oa3—42 to 60 inches; muck, dark brown (7.5YR 3/2) broken face, rubbed, and pressed; about 20 percent fiber, 5 percent rubbed; massive; slightly acid.

Range in Characteristics

Organic material:

Kind—muck
 Thickness—16 to more than 51 inches
 Content of fibers—10 to 45 percent unrubbed; 0 to 10 percent rubbed
 Content of wood fragments larger than 2 millimeters in size—0 to 15 percent
 Reaction—strongly acid to moderately alkaline
 Hue—7.5YR or 10YR
 Value—2 or 3
 Chroma—1 to 3

Typic Ochraqualfs

Drainage class: Very poorly drained to somewhat poorly drained

Permeability: Moderate to slow

Landform: Lake plains, moraines, and outwash plains

Parent material: Till or lacustrine sediments

Slope range: 0 to 2 percent

Taxonomic class: Typic Ochraqualfs

Sample Pedon

Location: Section 2, T. 143 N., R. 28 W.

A—0 to 3 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium granular structure; friable; many fine roots; slightly alkaline; abrupt smooth boundary.

E—3 to 15 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; friable; many fine roots; slightly alkaline; abrupt smooth boundary.

Btg1—15 to 29 inches; pale olive (5Y 6/3) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; weak very fine subangular blocky structure; friable; many fine roots; few distinct grayish brown (2.5Y 5/2) clay films on faces of pedis; about 2 percent gravel; moderately alkaline; clear smooth boundary.

Btg2—29 to 37 inches; light brownish gray (2.5Y 6/2) clay loam; common medium distinct light olive brown (2.5Y 5/4) mottles; weak thin platy structure parting to weak very fine subangular blocky; friable; few fine roots; few faint grayish brown (2.5Y 5/2) clay films on faces of pedis; about 2 percent gravel; moderately alkaline; clear smooth boundary.

BCg—37 to 48 inches; light olive gray (5Y 6/2) silty clay loam; moderate medium platy structure; firm; few fine roots; strong effervescence; about 2 percent gravel; moderately alkaline; clear smooth boundary.

Cg—48 to 60 inches; gray (5Y 6/1) silt loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive with moderate thin platy soil fragments; firm; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Content of gravel: 0 to 20 percent

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 to 4

Chroma—0 to 2

Texture—loam, fine sandy loam, silt loam, sandy loam, loamy sand, loamy fine sand, loamy very fine sand, clay loam, very fine sandy loam, or the gravelly analogs of these textures

E or Eg horizon (if it occurs):

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—loam, fine sandy loam, silt loam, silty clay loam, sandy loam, loamy sand, loamy fine sand, loamy very fine sand, very fine sandy loam, or the gravelly analogs of these textures

Btg horizon:

Hue—10YR, 5Y, or 2.5Y

Value—3 to 6

Chroma—1 or 2

Texture—loam, sandy loam, clay loam, fine sandy loam, very fine sandy loam, silt loam, silty clay loam, silty clay, clay, or the gravelly analogs of these textures

BCg horizon:

Hue—10YR, 5Y, or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, silt loam, very fine sandy loam, silty clay loam, or the gravelly analogs of these textures

Cg horizon:

Hue—10YR, 5Y, or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam, sandy loam, fine sandy loam, loamy fine sand, loamy sand, silt loam, very fine sandy loam, silty clay loam, or the gravelly analogs of these textures

Typic Udipsamments

Drainage class: Somewhat excessively drained or excessively drained

Permeability: Rapid

Landform: Moraines and outwash plains

Parent material: Sandy sediments

Slope range: 0 to 8 percent

Taxonomic class: Typic Udipsamments

Sample Pedon

Location: Section 14, T. 146 N., R. 29 W.

A—0 to 2 inches; dark brown (10YR 3/3) loamy sand; weak medium granular structure; very friable; many roots; very strongly acid; abrupt smooth boundary.

E—2 to 6 inches; pale brown (10YR 6/3) loamy sand; weak fine subangular blocky structure; very friable; many roots; moderately acid; clear wavy boundary.

Bw—6 to 16 inches; yellowish brown (10YR 5/6) loamy sand; weak medium subangular blocky structure;

very friable; many roots; moderately acid; gradual smooth boundary.

BC—16 to 22 inches; very pale brown (10YR 7/4) sand; single grain; loose; few roots; neutral; gradual smooth boundary.

C—22 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few roots; slightly acid.

Range in Characteristics

Content of gravel: 0 to 35 percent

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

E horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—2 or 3

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

BC horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—2 to 6

Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of these textures

Content of gravel—0 to 35 percent

C horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—2 to 6

Texture—sand, coarse sand, fine sand, loamy sand, loamy coarse sand, loamy fine sand, or the gravelly analogs of these textures

Udipsamments

Drainage class: Somewhat excessively drained or excessively drained

Permeability: Rapid

Landform: Outwash plains

Parent material: Sandy sediments

Slope range: 0 to 8 percent

Taxonomic class: Udipsamments

Sample Pedon

A—0 to 1 inch; very dark gray (10YR 3/1) fine sand; weak medium granular structure; very friable; many roots; very strongly acid; abrupt smooth boundary.

E—1 to 4 inches; dark gray (10YR 4/1) fine sand; weak fine subangular blocky structure; very friable; many roots; moderately acid; clear wavy boundary.

Bw—4 to 8 inches; dark yellowish brown (10YR 4/4) fine sand; weak medium subangular blocky structure; very friable; many roots; moderately acid; gradual smooth boundary.

BC—8 to 18 inches; yellowish brown (10YR 5/6) fine sand; single grain; loose; few roots; neutral; gradual smooth boundary.

C—18 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few roots; slightly acid.

Range in Characteristics

Content of gravel: 0 to 35 percent

Other features: A 2C horizon below a depth of 48 inches in some pedons, which consists of bands of sandy loam, fine sandy loam, clay loam, silt loam, or loam

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

E horizon:

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—1 to 3

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 6

Texture—loamy sand, sand, fine sand, loamy fine sand, coarse sand, loamy coarse sand, or the gravelly analogs of these textures

BC horizon (if it occurs):

Hue—10YR or 7.5YR

Value—4 to 7

Chroma—2 to 6

Texture—sand, coarse sand, fine sand, loamy sand,

loamy coarse sand, loamy fine sand, or the
gravelly analogs of these textures
Content of gravel—0 to 35 percent
C horizon:
Hue—10YR or 7.5YR

Value—4 to 7
Chroma—2 to 6
Texture—sand, coarse sand, fine sand, loamy sand,
loamy coarse sand, loamy fine sand, or the
gravelly analogs of these textures

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon.

Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in

diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Congeliturbate. Soil material disturbed by frost action.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that

follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but

periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic

processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt,

commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter

represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is

assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters,

porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those

horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile.

Permeability is measured as the number of inches

per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation

are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff

so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil

normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The

moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

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Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Walker Ah Gwah Ching, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>° F</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>	
January-----	16.9	-3.6	6.7	45	-35	0	0.76	0.24	1.18	2	11.5
February----	24.0	2.5	13.3	50	-31	1	.55	.21	.87	1	6.1
March-----	36.6	16.2	26.4	63	-20	16	1.47	.71	2.13	3	9.8
April-----	53.0	30.6	41.8	81	6	145	2.46	1.22	3.53	5	4.2
May-----	67.1	43.1	55.1	87	24	471	2.89	1.37	4.20	6	.0
June-----	74.9	52.3	63.6	90	37	709	4.00	2.44	5.39	8	.0
July-----	80.1	57.8	68.9	95	43	897	3.70	1.94	5.24	6	.0
August-----	77.1	55.3	66.2	94	40	811	3.39	1.43	5.05	6	.0
September---	66.3	45.7	56.0	88	27	479	2.98	1.51	4.27	6	.0
October-----	55.1	36.0	45.6	80	16	218	2.64	.80	4.13	4	.5
November----	36.3	21.1	28.7	63	-10	23	1.18	.44	1.80	3	6.7
December----	20.9	3.8	12.3	46	-28	1	.88	.42	1.28	3	9.9
Yearly:											
Average---	50.7	30.1	40.4	---	---	---	---	---	---	---	---
Extreme---	103	-39	---	97	-36	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,769	26.89	22.40	30.49	53	48.6

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Walker Ah Gwah Ching, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 30	May 17	May 24
2 years in 10 later than--	Apr. 26	May 11	May 20
5 years in 10 later than--	Apr. 18	May 1	May 13
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 6	Sept. 24	Sept. 12
2 years in 10 earlier than--	Oct. 11	Sept. 28	Sept. 17
5 years in 10 earlier than--	Oct. 21	Oct. 8	Sept. 26

TABLE 3.--GROWING SEASON

(Recorded in the period 1961-90 at Walker Ah Gwah Ching, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	<u>Days</u>	<u>Days</u>	<u>Days</u>
9 years in 10	165	137	117
8 years in 10	172	144	123
5 years in 10	185	158	135
2 years in 10	199	172	146
1 year in 10	206	179	152

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
7A	Hubbard loamy sand, 0 to 3 percent slopes-----	5,870	0.7
7B	Hubbard loamy sand, 3 to 8 percent slopes-----	2,031	0.2
48	Hiwood loamy fine sand-----	757	0.1
82B	Redeye loamy sand, 1 to 6 percent slopes-----	1,784	0.2
82C	Redeye loamy sand, 6 to 12 percent slopes-----	781	0.1
119B	Pomroy loamy sand, 3 to 8 percent slopes-----	10,512	1.3
119C	Pomroy loamy sand, 8 to 15 percent slopes-----	1,593	0.2
126B	Graycalm loamy sand, 1 to 8 percent slopes-----	3,385	0.4
126C	Graycalm loamy sand, 8 to 15 percent slopes-----	1,075	0.1
139B	Huntersville loamy fine sand, 1 to 6 percent slopes-----	6,969	0.9
142	Nokay loam-----	16,804	2.1
144B	Flak sandy loam, 3 to 8 percent slopes-----	8,243	1.0
144C	Flak sandy loam, 8 to 15 percent slopes-----	2,788	0.3
146B	Wabedo sandy loam, 1 to 6 percent slopes-----	30,812	3.8
147	Spooner very fine sandy loam-----	1,234	0.2
158B	Zimmerman fine sand, 1 to 8 percent slopes-----	2,310	0.3
167B	Baudette silt loam, 1 to 6 percent slopes-----	159	*
202	Meehan loamy sand-----	26,959	3.3
204B	Cushing loam, 2 to 8 percent slopes-----	7,487	0.9
204C	Cushing loam, 8 to 15 percent slopes-----	3,862	0.5
204E	Cushing loam, 15 to 30 percent slopes-----	279	*
217	Nokasippi loamy fine sand-----	9,915	1.2
218	Watab loamy sand-----	16,685	2.1
240A	Warba very fine sandy loam, 1 to 3 percent slopes, moderately wet-----	3,145	0.4
240B	Warba very fine sandy loam, 3 to 8 percent slopes-----	12,942	1.6
240C	Warba very fine sandy loam, 8 to 15 percent slopes-----	3,862	0.5
243	Stuntz very fine sandy loam-----	9,518	1.2
268B	Cromwell sandy loam, 1 to 8 percent slopes-----	6,212	0.8
268C	Cromwell sandy loam, 8 to 15 percent slopes-----	1,275	0.2
292	Alstad fine sandy loam-----	5,017	0.6
453B	Demontreville loamy sand, 2 to 8 percent slopes-----	9,238	1.1
453C	Demontreville loamy sand, 8 to 15 percent slopes-----	10,671	1.3
453E	Demontreville loamy sand, 15 to 40 percent slopes-----	3,225	0.4
454B	Mahtomedi loamy sand, 1 to 8 percent slopes-----	7,725	0.9
454C	Mahtomedi loamy sand, 8 to 15 percent slopes-----	6,610	0.8
454E	Mahtomedi loamy sand, 15 to 40 percent slopes-----	5,296	0.7
458A	Menahga loamy sand, 0 to 3 percent slopes-----	12,463	1.5
458B	Menahga loamy sand, 3 to 8 percent slopes-----	23,653	2.9
458C	Menahga loamy sand, 8 to 15 percent slopes-----	4,261	0.5
458E	Menahga loamy sand, 15 to 40 percent slopes-----	2,310	0.3
540	Seelyeville muck-----	38,763	4.8
541	Rifle mucky peat-----	21,305	2.6
543	Markey muck-----	22,340	2.7
544	Cathro muck-----	16,964	2.1
549	Greenwood peat-----	14,376	1.8
564	Friendship loamy sand-----	30,145	3.7
620B	Cutaway loamy sand, 1 to 10 percent slopes-----	10,235	1.3
620D	Cutaway loamy sand, 10 to 25 percent slopes-----	2,389	0.3
625	Sandwick loamy sand-----	4,739	0.6
665B	Menahga loamy sand, moraine, 3 to 8 percent slopes-----	7,247	0.9
665C	Menahga loamy sand, moraine, 8 to 15 percent slopes-----	6,013	0.7
665E	Menahga loamy sand, moraine, 15 to 40 percent slopes-----	4,380	0.5
679B	Menahga loamy sand, loamy substratum, 2 to 8 percent slopes-----	7,685	0.9
679C	Menahga loamy sand, loamy substratum, 8 to 15 percent slopes-----	32,151	4.0
684	Bergkeller sandy loam, moderately wet-----	2,589	0.3
701	Runeberg mucky loam, depressional-----	3,400	0.4
703	Paddock loam-----	1,701	0.2
720B	Blowers sandy loam, 1 to 5 percent slopes-----	976	0.1
730A	Sanburn sandy loam, 1 to 3 percent slopes-----	4,380	0.5
730B	Sanburn sandy loam, 3 to 8 percent slopes-----	5,972	0.7
730C	Sanburn sandy loam, 8 to 15 percent slopes-----	1,354	0.2

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
731A	Sanburn loamy sand, 0 to 3 percent slopes-----	4,699	0.6
731B	Sanburn loamy sand, 3 to 8 percent slopes-----	2,151	0.3
731C	Sanburn loamy sand, 8 to 15 percent slopes-----	438	0.1
732	Bushville loamy sand, 1 to 3 percent slopes-----	3,544	0.4
739B	Wabedo sandy loam, 1 to 6 percent slopes, very stony-----	5,256	0.6
742B	Flak sandy loam, 3 to 8 percent slopes, very stony-----	1,831	0.2
742C	Flak sandy loam, 8 to 15 percent slopes, very stony-----	40	*
750B	Pomroy loamy sand, 3 to 8 percent slopes, very stony-----	2,946	0.4
750C	Pomroy loamy sand, 8 to 15 percent slopes, very stony-----	597	0.1
773B	Warba-Cromwell complex, 1 to 8 percent slopes-----	4,858	0.6
773E	Warba-Cromwell complex, 8 to 25 percent slopes-----	3,305	0.4
788	Cathro-Seelyville complex-----	8,880	1.1
797	Mooselake and Lupton soils-----	13,500	1.7
799	Bowstring-Seelyville complex, frequently flooded-----	5,375	0.7
870B	Itasca-Goodland complex, 1 to 8 percent slopes-----	2,907	0.4
870C	Itasca-Goodland complex, 8 to 15 percent slopes-----	1,752	0.2
928B	Demontreville-Mahtomedi-Cushing complex, 2 to 8 percent slopes-----	9,278	1.1
928C	Demontreville-Mahtomedi-Cushing complex, 8 to 15 percent slopes-----	15,172	1.9
928E	Demontreville-Mahtomedi-Cushing complex, 15 to 40 percent slopes-----	9,597	1.2
1002	Fluvaquents, frequently flooded-----	8,322	1.0
1141	Runeberg loam, acid substratum, depressional-----	6,327	0.8
1151B	Blowers sandy loam, acid substratum, 1 to 5 percent slopes-----	1,812	0.2
1153B	Huntersville loamy sand, acid substratum, 1 to 6 percent slopes-----	12,942	1.6
1155	Staples loamy sand, acid substratum-----	9,331	1.1
1157	Paddock loam, acid substratum-----	3,157	0.4
1160B	Redeye loamy sand, acid substratum, 1 to 6 percent slopes-----	3,313	0.4
1160C	Redeye loamy sand, acid substratum, 6 to 12 percent slopes-----	1,449	0.2
1943	Roscommon loamy sand-----	19,353	2.4
1956	Staples loamy sand-----	5,004	0.6
1957B	Friendship loamy sand, loamy substratum, 1 to 6 percent slopes-----	21,543	2.6
1970B	Menahga loamy sand, till substratum, 2 to 8 percent slopes-----	7,287	0.9
1970C	Menahga loamy sand, till substratum, 8 to 15 percent slopes-----	2,269	0.3
1978	Nokay loam, very stony-----	3,345	0.4
1995B	Bergkeller sandy loam, 1 to 6 percent slopes-----	6,770	0.8
1996	Cromwell sandy loam, moderately wet-----	3,544	0.4
	Water-----	73,113	9.0
	Total**-----	813,828	100.0

* Less than 0.1 percent.

** The total acreage does not include 731,872 acres in the Chippewa National Forest.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
144B	Flak sandy loam, 3 to 8 percent slopes
146B	Wabedo sandy loam, 1 to 6 percent slopes
147	Spooner very fine sandy loam (where drained)
167B	Baudette silt loam, 1 to 6 percent slopes
204B	Cushing loam, 2 to 8 percent slopes
240A	Warba very fine sandy loam, 1 to 3 percent slopes, moderately wet
240B	Warba very fine sandy loam, 3 to 8 percent slopes
243	Stuntz very fine sandy loam (where drained)
292	Alstad fine sandy loam (where drained)
720B	Blowers sandy loam, 1 to 5 percent slopes
1151B	Blowers sandy loam, acid substratum, 1 to 5 percent slopes
1157	Paddock loam, acid substratum (where drained)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Oats	Corn silage	Corn	Brome-grass- alfalfa hay	Soybeans	Kentucky bluegrass
		<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>AUM*</u>
7A----- Hubbard	4s	55	8	55	2.2	10	1.5
7B----- Hubbard	4s	50	7	50	2.2	10	1.5
4B----- Hiwood	4s	45	---	---	2.5	---	2.0
82B----- Redeye	3s	65	11	60	3.0	---	2.0
82C----- Redeye	3e	60	10	50	3.0	---	1.5
119B----- Pomroy	3s	65	11	65	3.0	25	1.5
119C----- Pomroy	4s	60	10	60	2.5	20	1.5
126B----- Graycalm	4s	40	9	40	---	---	---
126C----- Graycalm	6s	30	8	30	---	---	---
139B----- Huntersville	3s	65	9	60	3.0	---	2.0
142----- Nokay	2w	70	12	60	3.0	30	3.0
144B----- Flak	2e	70	12	65	3.7	25	3.0
144C----- Flak	3e	65	11	60	3.2	20	2.0
146B----- Wabedo	2e	75	12	75	4.5	30	3.0
147----- Spooner	4w	45	---	---	---	---	3.0
158B----- Zimmerman	4s	---	---	---	1.7	15	2.0
167B----- Baudette	2e	80	---	---	4.0	40	3.0
202----- Meehan	4w	45	9	45	2.5	20	2.0
204B----- Cushing	2e	80	17	80	4.5	35	4.3

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Oats	Corn silage	Corn	Bromegrass- alfalfa hay	Soybeans	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Bu	AUM*
204C----- Cushing	3e	70	15	70	5.0	30	4.0
204E----- Cushing	6e	50	11	65	4.0	---	3.0
217----- Nokasippi	6w	---	---	---	---	---	3.0
218----- Watab	3w	70	10	60	2.5	20	2.0
240A----- Warba	2e	80	---	---	4.2	25	4.0
240B----- Warba	2e	75	---	---	4.1	23	3.9
240C----- Warba	3e	70	---	---	4.0	20	3.7
243----- Stuntz	2w	65	---	---	---	---	3.5
268B----- Cromwell	3e	70	10	65	3.7	---	1.5
268C----- Cromwell	4e	65	9	60	3.2	---	1.5
292----- Alstad	2w	70	14	70	4.0	30	4.1
453B----- Demontreville	3s	65	10	65	4.0	25	2.0
453C----- Demontreville	4e	55	8	55	3.5	---	1.6
453E----- Demontreville	7e	---	---	---	---	---	1.0
454B----- Mahtomedi	4s	35	6	35	2.5	---	1.4
454C----- Mahtomedi	6s	30	5	30	2.2	---	1.2
454E----- Mahtomedi	7s	---	---	---	---	---	0.8
458A, 458B, 458C----- Menahga	4s	35	6	35	2.3	---	1.2
458E----- Menahga	7s	---	---	---	---	---	0.7
540----- Seelyeville	6w	---	---	---	---	---	2.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Oats	Corn silage	Corn	Bromegrass- alfalfa hay	Soybeans	Kentucky bluegrass
		<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>AUM*</u>
541----- Rifle	6w	---	---	---	---	---	---
543----- Markey	6w	---	---	---	---	---	---
544----- Cathro	6w	---	---	---	---	---	---
549----- Greenwood	7w	---	---	---	---	---	---
564----- Friendship	4s	55	10	55	2.5	20	1.3
620B----- Cutaway	3s	65	---	---	3.5	---	2.6
620D----- Cutaway	4e	60	---	---	2.6	---	2.4
625----- Sandwich	3w	50	---	---	---	---	3.0
665B, 665C----- Menahga	4s	40	6	40	---	---	1.2
665E----- Menahga	7s	---	---	---	---	---	0.7
679B, 679C----- Menahga	4s	45	7	45	2.3	---	2.0
684----- Bergkeller	2s	75	12	---	2.0	---	---
701----- Runeberg	6w	---	---	---	---	---	---
703----- Paddock	2w	75	14	60	3.0	---	3.0
720B----- Blowers	2e	80	15	70	4.5	30	3.0
730A, 730B----- Sanburn	3e	65	10	70	---	25	---
730C----- Sanburn	4e	55	10	55	---	22	---
731A, 731B----- Sanburn	3s	55	9	55	---	22	---
731C----- Sanburn	4e	50	8	50	---	20	---
732----- Bushville	3s	65	10	65	---	30	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Oats	Corn silage	Corn	Bromegrass- alfalfa hay	Soybeans	Kentucky bluegrass
		Bu	Tons	Bu	Tons	Bu	AUM*
739B----- Wabeddb	6s	---	---	---	---	---	2.8
742B----- Flak	6s	---	---	---	---	---	2.0
742C----- Flak	7s	---	---	---	---	---	---
750B, 750C----- Pomroy	6s	---	---	---	2.0	---	1.0
773B----- Warba----- Cromwell-----	2e 3e	75	---	---	4.2	25	3.0
773E----- Warba----- Cromwell-----	4e 6e	---	---	---	3.4	---	2.5
788----- Cathro- Seelyeville	6w	---	---	---	---	---	---
797----- Mooselake----- Lupton-----	6w 7w	---	---	---	---	---	---
799----- Bowstring- Seelyeville	6w	---	---	---	---	---	---
870B----- Itasca-Goodland	2e	70	---	---	4.0	---	2.0
870C----- Itasca-Goodland	3e	65	---	---	3.7	---	1.5
928B----- Demontreville-- Mahtomedi----- Cushing-----	3s 4s 2e	60	10	60	3.8	20	2.2
928C----- Demontreville-- Mahtomedi----- Cushing-----	4e 6s 3e	55	9	55	3.5	15	1.8
928E----- Demontreville-- Mahtomedi----- Cushing-----	7e 7s 6e	---	---	---	---	---	1.5
1002----- Fluvaquents	6w	---	---	---	---	---	2.5
1141----- Runeberg	6w	---	---	---	---	---	---
1151B----- Blowers	2e	75	13	70	4.0	25	3.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Oats	Corn silage	Corn	Bromegrass- alfalfa hay	Soybeans	Kentucky bluegrass
		<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>Tons</u>	<u>Bu</u>	<u>AUM*</u>
1153B----- Huntersville	3s	60	8	60	2.5	---	3.0
1155----- Staples	3w	55	12	55	2.0	---	3.0
1157----- Paddock	2w	70	11	60	2.5	---	3.0
1160B----- Redeye	3s	60	10	60	2.5	---	---
1160C----- Redeye	3e	55	9	50	2.5	---	---
1943----- Roscommon	6w	---	---	---	---	---	---
1956----- Staples	3w	60	13	60	2.2	---	3.0
1957B----- Friendship	3s	60	11	60	3.0	25	1.8
1970B, 1970C--- Menahga	4s	50	7	50	2.5	---	2.0
1978----- Nokay	6s	---	---	---	---	---	3.0
1995B----- Bergkeller	3e	70	11	---	1.8	---	---
1996----- Cromwell	3s	70	12	---	4.0	---	1.7

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
7A, 7B----- Hubbard	6A	Slight	Slight	Slight	Slight	Red pine-----	55	6	Red pine, eastern white pine, jack pine, white spruce.
						Eastern white pine--	56	8	
						Jack pine-----	60	6	
						White spruce-----	55	7	
						Bur oak-----	40	2	
48----- Hiwood	8W	Slight	Moderate	Moderate	Moderate	Shagbark hickory---	40	---	Red pine, jack pine, white spruce.
						Red pine-----	64	8	
						Eastern white pine--	46	5	
						Jack pine-----	63	6	
						White spruce-----	50	8	
						Balsam fir-----	59	8	
						Black spruce-----	52	3	
82B, 82C----- Redeye	6S	Slight	Moderate	Moderate	Slight	Quaking aspen-----	71	6	Red pine, white spruce, eastern white pine, jack pine, northern red oak.
						Quaking aspen-----	78	6	
						Red pine-----	67	8	
						Jack pine-----	61	6	
						Bur oak-----	40	2	
						Bigtooth aspen-----	75	6	
						Northern red oak----	45	2	
119B, 119C----- Pomroy	4S	Slight	Moderate	Moderate	Slight	Eastern white pine--	55	7	Northern red oak, red pine, jack pine, eastern white pine, white spruce.
						Northern red oak----	64	4	
						Red pine-----	60	7	
						Jack pine-----	65	7	
						Bigtooth aspen-----	72	6	
						Bur oak-----	50	2	
						Paper birch-----	60	4	
126B, 126C----- Graycalm	7A	Slight	Slight	Slight	Slight	Quaking aspen-----	70	6	Red pine, eastern white pine, white spruce, jack pine, balsam fir, Carolina poplar.
						Red pine-----	61	7	
						Jack pine-----	67	7	
						Quaking aspen-----	65	5	
						Eastern white pine--	55	7	
						White spruce-----	60	8	
						Paper birch-----	60	4	
139B----- Huntersville	6L	Slight	Severe	Slight	Slight	Northern red oak----	55	3	Red pine, white spruce, eastern white pine, jack pine.
						Balsam fir-----	58	8	
						Quaking aspen-----	77	6	
						Red pine-----	55	6	
						Jack pine-----	58	6	
						Bigtooth aspen-----	75	6	
						Northern red oak----	45	2	
142----- Nokay	5W	Slight	Severe	Slight	Moderate	Bur oak-----	40	2	White spruce.
						Eastern white pine--	55	7	
						Quaking aspen-----	68	5	
						Sugar maple-----	60	3	
						American basswood---	65	4	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
144B, 144C----- Flak	3A	Slight	Moderate	Slight	Slight	Northern red oak----	58	3	Red pine, white spruce, eastern white pine, northern red oak, jack pine.
						Bur oak-----	54	3	
						Quaking aspen-----	70	6	
						American basswood---	60	4	
						Jack pine-----	60	6	
						Bigtooth aspen-----	72	6	
						Paper birch-----	60	4	
146B----- Wabedo	4W	Slight	Moderate	Slight	Moderate	Northern red oak----	65	4	White spruce, northern red oak, eastern white pine.
						Quaking aspen-----	70	6	
						American basswood---	60	4	
147----- Spoonier	7W	Slight	Severe	Slight	Moderate	Quaking aspen-----	83	7	White spruce, black spruce, black ash, green ash, silver maple.
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						Black ash-----	65	3	
						American elm-----	---	---	
						White spruce-----	60	8	
158B----- Zimmerman	8S	Slight	Moderate	Moderate	Slight	Red pine-----	62	8	Red pine, eastern white pine, jack pine, balsam fir.
						Jack pine-----	66	7	
						Paper birch-----	65	5	
						Quaking aspen-----	75	6	
						Balsam fir-----	65	9	
						Northern red oak----	53	3	
						Eastern white pine--	76	12	
						White spruce-----	65	9	
167B----- Baudette	7L	Slight	Severe	Slight	Slight	Quaking aspen-----	85	7	Balsam fir, white spruce, eastern white pine, red pine.
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						Black ash-----	65	3	
						American elm-----	---	---	
						White spruce-----	60	8	
						Bur oak-----	63	4	
						American basswood---	67	4	
						Sugar maple-----	65	3	
						Eastern white pine--	55	7	
202----- Meehan	6W	Slight	Moderate	Moderate	Moderate	Jack pine-----	60	6	Jack pine, red pine, balsam fir, eastern white pine, white spruce, red maple.
						Red pine-----	60	7	
						Quaking aspen-----	70	6	
						Paper birch-----	60	4	
						Balsam fir-----	59	8	
						Eastern white pine--	55	7	
204B, 204C----- Cushing	6L	Slight	Moderate	Slight	Slight	Quaking aspen-----	78	6	Northern red oak, American basswood, balsam fir, white spruce, yellow birch.
						Northern red oak----	66	4	
						American basswood---	69	4	
						Bigtooth aspen-----	82	7	
						Balsam fir-----	56	8	
						Paper birch-----	65	5	
						Sugar maple-----	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
204E----- Cushing	6R	Moderate	Moderate	Moderate	Slight	Quaking aspen-----	78	6	Northern red oak, American basswood, balsam fir, white spruce, yellow birch.
						Northern red oak----	66	4	
						American basswood---	69	4	
						Bigtooth aspen-----	82	7	
						Balsam fir-----	56	8	
						Paper birch-----	65	5	
218----- Watab	6W	Slight	Moderate	Moderate	Moderate	Sugar maple-----	---	---	White spruce.
						Quaking aspen-----	72	6	
						White spruce-----	51	7	
240A----- Warba	7L	Slight	Moderate	Slight	Slight	American basswood---	60	4	White spruce, balsam fir, eastern white pine, northern red oak.
						Quaking aspen-----	82	7	
						Paper birch-----	74	6	
						Sugar maple-----	70	5	
						Northern red oak----	60	3	
						Balsam fir-----	70	5	
						Eastern white pine--	60	8	
						Red pine-----	60	8	
						White spruce-----	68	9	
240B, 240C----- Warba	6L	Slight	Moderate	Slight	Slight	Bigtooth aspen-----	63	9	White spruce, balsam fir, eastern white pine, northern red oak.
						Quaking aspen-----	81	7	
						Paper birch-----	76	6	
						American basswood---	74	6	
						Sugar maple-----	70	5	
						Northern red oak----	60	3	
						Balsam fir-----	67	4	
						Eastern white pine--	60	8	
						Red pine-----	55	7	
243----- Stuntz	7W	Slight	Severe	Slight	Moderate	White spruce-----	68	9	White spruce, eastern white pine, balsam fir.
						Bigtooth aspen-----	63	9	
						Quaking aspen-----	85	7	
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						American basswood---	65	4	
268B, 268C----- Cromwell	8S	Slight	Slight	Moderate	Slight	American elm-----	---	---	Red pine, jack pine, eastern white pine.
						Sugar maple-----	55	2	
						White spruce-----	60	8	
						Red pine-----	65	8	
						Quaking aspen-----	78	6	
						Paper birch-----	68	5	
						Northern red oak----	68	4	
						Jack pine-----	68	7	
						Balsam fir-----	59	8	
292----- Alstad	7W	Slight	Severe	Slight	Moderate	American basswood---	72	5	Northern red oak, American basswood, balsam fir, white spruce, yellow birch.
						Eastern white pine--	55	7	
						Bigtooth aspen-----	79	6	
						Sugar maple-----	60	3	
						Quaking aspen-----	82	7	
						Northern red oak----	---	---	
						American basswood---	---	---	
						Bigtooth aspen-----	---	---	
						Balsam fir-----	---	---	
						Paper birch-----	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
453B, 453C----- Demontreville	8S	Slight	Slight	Moderate	Slight	Red pine-----	62	8	Red pine, white spruce, jack pine.
						Eastern white pine--	54	7	
						Jack pine-----	69	7	
						White spruce-----	55	7	
						Northern red oak----	59	3	
						American basswood---	60	4	
						Quaking aspen-----	72	6	
						Bigtooth aspen-----	77	6	
453E----- Demontreville	8R	Moderate	Moderate	Moderate	Slight	Red pine-----	62	8	Red pine, white spruce, jack pine.
						Eastern white pine--	54	7	
						Jack pine-----	69	7	
						White spruce-----	55	7	
						Northern red oak----	59	3	
						American basswood---	60	4	
						Quaking aspen-----	72	6	
						Bigtooth aspen-----	77	6	
454B, 454C----- Mahtomedi	8S	Slight	Moderate	Moderate	Slight	Red pine-----	64	8	Red pine, jack pine, eastern white pine, white spruce.
						White spruce-----	62	8	
						Jack pine-----	69	7	
						Eastern white pine--	59	8	
						Bigtooth aspen-----	77	6	
454E----- Mahtomedi	8R	Moderate	Moderate	Moderate	Slight	Red pine-----	64	8	Red pine, jack pine, eastern white pine, white spruce.
						White spruce-----	62	8	
						Jack pine-----	69	7	
						Eastern white pine--	59	8	
						Bigtooth aspen-----	77	6	
458A, 458B, 458C----- Menahga	6S	Slight	Moderate	Moderate	Slight	Jack pine-----	59	6	Red pine, white spruce, eastern white pine, jack pine.
						Red pine-----	60	7	
						Eastern white pine--	55	7	
						Quaking aspen-----	65	5	
						Paper birch-----	60	4	
458E----- Menahga	6R	Moderate	Moderate	Moderate	Slight	Jack pine-----	59	6	Red pine, white spruce, eastern white pine, jack pine.
						Red pine-----	60	7	
						Eastern white pine--	55	7	
						Quaking aspen-----	65	5	
						Paper birch-----	60	4	
541----- Rifle	3W	Slight	Severe	Severe	Severe	Black spruce-----	35	3	Black spruce, tamarack, balsam fir, northern whitecedar.
						Tamarack-----	60	4	
						Northern whitecedar--	30	3	
						Balsam fir-----	45	6	
						Black ash-----	50	2	
549----- Greenwood	4W	Slight	Severe	Severe	Severe	Black spruce-----	39	4	Black spruce, tamarack.
						Tamarack-----	46	2	
564----- Friendship	7S	Slight	Moderate	Moderate	Slight	Jack pine-----	68	7	Red pine, eastern white pine, jack pine, white spruce.
						Red pine-----	60	7	
						Quaking aspen-----	68	5	
						Bigtooth aspen-----	74	6	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
620B----- Cutaway	6S	Slight	Moderate	Moderate	Slight	Quaking aspen-----	75	6	White spruce, red pine, eastern white pine, jack pine, balsam fir.
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						Red pine-----	62	8	
						Jack pine-----	65	7	
						Eastern white pine--	55	7	
						White spruce-----	60	8	
						Northern red oak----	60	4	
620D----- Cutaway	6R	Moderate	Moderate	Moderate	Slight	Northern whitecedar-	41	4	White spruce, red pine, eastern white pine, jack pine, balsam fir.
						Quaking aspen-----	75	6	
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						Red pine-----	62	8	
						Jack pine-----	65	7	
						Eastern white pine--	55	7	
						White spruce-----	60	8	
625----- Sandwich	7W	Slight	Moderate	Slight	Moderate	Northern red oak----	60	4	White spruce, eastern white pine, balsam fir.
						Northern whitecedar-	41	4	
						Quaking aspen-----	85	7	
						Paper birch-----	65	5	
						Balsam fir-----	73	10	
665B, 665C----- Menahga	9S	Slight	Slight	Moderate	Slight	Eastern white pine--	55	7	Red pine, jack pine, eastern white pine, balsam fir.
						Black ash-----	65	3	
						Red pine-----	71	9	
						Jack pine-----	68	7	
						Balsam fir-----	60	8	
665E----- Menahga	9R	Moderate	Moderate	Moderate	Moderate	Quaking aspen-----	70	6	Red pine, jack pine, eastern white pine, balsam fir.
						Eastern white pine--	58	8	
						Red pine-----	71	9	
						Jack pine-----	68	7	
						Balsam fir-----	60	8	
679B, 679C----- Menahga	6S	Slight	Slight	Moderate	Slight	Quaking aspen-----	70	6	Red pine, jack pine.
						Northern red oak----	45	2	
						Bur oak-----	40	2	
						Jack pine-----	60	6	
						Red pine-----	55	6	
684----- Bergkeller	7A	Slight	Slight	Slight	Slight	Quaking aspen-----	75	6	Jack pine, red pine, northern red oak, bigtooth aspen.
						Northern red oak----	45	2	
						Bur oak-----	40	2	
						Jack pine-----	65	7	
						Red pine-----	68	9	
701----- Runeberg	3W	Slight	Severe	Severe	Severe	Paper birch-----	---	---	Black ash, black spruce, green ash, tamarack.
						Bigtooth aspen-----	---	---	
						Bur oak-----	---	---	
						Black ash-----	60	3	
						Green ash-----	60	4	
						Quaking aspen-----	75	6	
						White oak-----	55	3	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
703----- Paddock	4W	Slight	Severe	Slight	Moderate	Northern red oak----	60	4	White spruce, green ash, northern red oak, red pine.
						Quaking aspen-----	72	6	
						White spruce-----	45	6	
						Black ash-----	66	3	
						American elm-----	50	---	
						White oak-----	57	3	
						Green ash-----	66	4	
720B----- Blowers	6L	Slight	Severe	Slight	Slight	Quaking aspen-----	72	6	Red pine, white spruce, eastern white pine, northern red oak, green ash, jack pine.
						Northern red oak----	65	4	
						American basswood---	75	5	
						Red pine-----	67	8	
						White oak-----	55	3	
						American elm-----	55	---	
						Jack pine-----	70	7	
730A, 730B, 730C, 731A, 731B, 731C----- Sanburn	7A	Slight	Slight	Slight	Slight	White spruce-----	52	7	
						Jack pine-----	65	7	Red pine, jack pine, northern red oak, white spruce, bigtooth aspen.
						Northern red oak----	55	3	
						Paper birch-----	---	---	
						Bigtooth aspen-----	---	---	
732----- Bushville	4S	Slight	Slight	Moderate	Slight	Bur oak-----	---	---	Jack pine, eastern white pine, red pine, white spruce, northern red oak.
						Northern red oak----	64	4	
						Red pine-----	60	7	
						Jack pine-----	65	7	
						Bigtooth aspen-----	75	6	
						Quaking aspen-----	75	6	
739B----- Wabedo	4X	Slight	Moderate	Slight	Moderate	Paper birch-----	65	5	
						Bur oak-----	60	4	Tamarack.
						White spruce-----	60	8	
						Eastern white pine--	60	8	
742B, 742C----- Flak	3X	Slight	Moderate	Slight	Moderate	Balsam fir-----	62	8	
						Northern red oak----	58	3	Red pine, white spruce, eastern white pine, northern red oak, jack pine.
						Bur oak-----	54	3	
						Quaking aspen-----	70	6	
						American basswood---	60	4	
						Jack pine-----	60	6	
750B, 750C----- Pomroy	4S	Slight	Moderate	Moderate	Slight	Bigtooth aspen-----	72	6	
						Paper birch-----	60	4	Northern red oak, red pine, jack pine, eastern white pine, white spruce.
						Northern red oak----	64	4	
						Red pine-----	60	7	
						Jack pine-----	65	7	
						Bigtooth aspen-----	72	6	
						Bur oak-----	50	2	
						Paper birch-----	60	4	
						Quaking aspen-----	70	6	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
773B: Warba-----	6L	Slight	Moderate	Slight	Slight	Quaking aspen-----	76	6	White spruce, balsam fir, eastern white pine, northern red oak.
						Paper birch-----	74	6	
						American basswood---	70	5	
						Sugar maple-----	60	3	
						Northern red oak----	67	4	
						Balsam fir-----	60	8	
						Eastern white pine--	55	7	
						Red pine-----	68	9	
						White spruce-----	63	9	
Cromwell-----	8S	Slight	Slight	Moderate	Slight	Bigtooth aspen-----	81	7	Red pine, jack pine, eastern white pine.
						Red pine-----	65	8	
						Quaking aspen-----	78	6	
						Paper birch-----	68	5	
						Northern red oak----	68	4	
						Jack pine-----	68	7	
						Balsam fir-----	59	8	
						American basswood---	72	5	
						Eastern white pine--	55	7	
773E: Warba-----	6R	Moderate	Moderate	Slight	Slight	Bigtooth aspen-----	79	6	White spruce, balsam fir, eastern white pine, northern red oak.
						Sugar maple-----	60	3	
						Quaking aspen-----	76	6	
						Paper birch-----	74	6	
						American basswood---	70	5	
						Sugar maple-----	60	3	
						Northern red oak----	67	4	
						Balsam fir-----	60	8	
						Eastern white pine--	55	7	
Cromwell-----	8R	Moderate	Moderate	Moderate	Slight	Red pine-----	68	9	Red pine, jack pine, eastern white pine.
						White spruce-----	63	9	
						Bigtooth aspen-----	81	7	
						Quaking aspen-----	78	6	
						Paper birch-----	68	5	
						Northern red oak----	68	4	
						Jack pine-----	68	7	
						Balsam fir-----	59	8	
						American basswood---	72	5	
797: Mooselake-----	2W	Slight	Severe	Severe	Severe	Eastern white pine--	55	7	Black spruce, balsam fir, northern whitecedar.
						Bigtooth aspen-----	79	6	
						Sugar maple-----	60	3	
						Black ash-----	55	2	
						Northern whitecedar-	31	3	
						Balsam fir-----	50	7	
Lupton-----	2W	Slight	Severe	Severe	Severe	Black spruce-----	40	3	Black spruce, balsam fir, northern whitecedar.
						Tamarack-----	50	3	
						Paper birch-----	---	---	
						Black ash-----	55	2	
						Northern whitecedar-	31	3	
						Balsam fir-----	50	7	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
870B, 870C: Itasca-----	7A	Slight	Moderate	Slight	Slight	Quaking aspen-----	84	7	White spruce, eastern white pine, balsam fir, jack pine, northern red oak, yellow birch.
						Bigtooth aspen-----	86	7	
						Paper birch-----	69	6	
						Balsam fir-----	63	9	
						Northern red oak----	69	4	
						Sugar maple-----	60	3	
						American basswood---	69	4	
						White spruce-----	60	8	
						Eastern white pine--	60	8	
						Red pine-----	60	7	
Goodland-----	7L	Slight	Moderate	Slight	Slight	Quaking aspen-----	80	7	White spruce, eastern white pine, jack pine, northern red oak, balsam fir, yellow birch.
						Paper birch-----	65	5	
						Balsam fir-----	60	8	
						Northern red oak----	68	4	
						Sugar maple-----	54	2	
						American basswood---	65	4	
						White spruce-----	60	8	
						Eastern white pine--	55	7	
						Red pine-----	60	7	
						Bigtooth aspen-----	84	7	
928B, 928C: Demontreville--	8S	Slight	Slight	Moderate	Slight	Red pine-----	62	8	Red pine, white spruce, jack pine.
						Eastern white pine--	54	7	
						Jack pine-----	69	7	
						White spruce-----	55	7	
						Northern red oak----	59	3	
						American basswood---	60	4	
						Quaking aspen-----	72	6	
						Bigtooth aspen-----	77	6	
Mahtomedi-----	8S	Slight	Moderate	Moderate	Slight	Red pine-----	64	8	Red pine, jack pine, eastern white pine, white spruce.
						White spruce-----	62	8	
						Jack pine-----	69	7	
						Eastern white pine--	59	8	
						Bigtooth aspen-----	77	6	
Cushing-----	6L	Slight	Moderate	Slight	Slight	Quaking aspen-----	78	6	Northern red oak, American basswood, balsam fir, white spruce, yellow birch.
						Northern red oak----	66	4	
						American basswood---	69	4	
						Bigtooth aspen-----	82	7	
						Balsam fir-----	56	8	
						Paper birch-----	65	5	
						Sugar maple-----	---	---	
928E: Demontreville--	8R	Moderate	Moderate	Moderate	Slight	Red pine-----	62	8	Red pine, white spruce, jack pine.
						Eastern white pine--	54	7	
						Jack pine-----	69	7	
						White spruce-----	55	7	
						Northern red oak----	59	3	
						American basswood---	60	4	
						Quaking aspen-----	72	6	
						Bigtooth aspen-----	77	6	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
928E: Mahtomedi-----	8R	Moderate	Moderate	Moderate	Slight	Red pine----- White spruce----- Jack pine----- Eastern white pine-- Bigtooth aspen-----	64 62 69 59 77	8 8 7 8 6	Red pine, jack pine, eastern white pine, white spruce.
Cushing-----	6R	Moderate	Moderate	Moderate	Slight	Quaking aspen----- Northern red oak---- American basswood--- Bigtooth aspen----- Balsam fir----- Paper birch----- Sugar maple-----	78 66 69 82 56 65 ---	6 4 4 7 8 5 ---	Northern red oak, American basswood, balsam fir, white spruce, yellow birch.
1141----- Runeberg	3W	Slight	Severe	Moderate	Severe	Black ash----- Green ash----- Quaking aspen----- White oak-----	61 64 79 55	3 4 6 3	Black ash, black spruce, green ash, tamarack.
1151B----- Blowers	6L	Slight	Severe	Slight	Slight	Quaking aspen----- Northern red oak---- American basswood--- Red pine----- White oak----- American elm----- Jack pine----- White spruce-----	72 65 75 67 55 55 70 52	6 4 5 8 3 --- 7 7	Red pine, white spruce, eastern white pine, northern red oak, green ash, jack pine.
1153B----- Huntersville	6L	Slight	Severe	Slight	Slight	Quaking aspen----- Red pine----- Jack pine----- Bigtooth aspen----- Northern red oak---- Bur oak----- Eastern white pine--	77 55 58 75 45 40 55	6 6 6 6 2 2 7	Red pine, white spruce, eastern white pine, jack pine.
1155----- Staples	6W	Slight	Severe	Moderate	Severe	Quaking aspen----- Black ash----- Jack pine----- Northern red oak---- White oak----- American elm-----	71 45 60 45 --- ---	6 2 6 2 --- ---	White spruce, black spruce, balsam fir, green ash.
1157----- Paddock	4W	Slight	Severe	Slight	Moderate	Northern red oak---- Quaking aspen----- White spruce----- Black ash----- American elm----- White oak----- Green ash-----	60 72 45 66 50 57 66	4 6 6 3 --- 3 4	White spruce, green ash, northern red oak, red pine.
1160B, 1160C--- Redeye	6S	Slight	Moderate	Moderate	Slight	Quaking aspen----- Red pine----- Jack pine----- Bur oak----- Bigtooth aspen----- Northern red oak---- Eastern white pine--	78 67 61 40 75 45 55	6 8 6 2 6 2 7	Red pine, white spruce, eastern white pine, jack pine, northern red oak.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	Common trees	Site index	Productivity class*	
1943----- Roscommon	3W	Slight	Severe	Severe	Severe	Black spruce-----	35	3	Black spruce, balsam fir, northern whitecedar.
						Tamarack-----	50	3	
						Balsam fir-----	50	7	
						Northern whitecedar-----	35	4	
						Black ash-----	55	2	
						Quaking aspen-----	60	4	
1956----- Staples	6W	Slight	Severe	Moderate	Severe	Quaking aspen-----	71	6	White spruce, black spruce, balsam fir, green ash.
						Black ash-----	45	2	
						Jack pine-----	60	6	
						Northern red oak----	45	2	
						White oak-----	---	---	
						American elm-----	---	---	
1957B----- Friendship	7S	Slight	Moderate	Moderate	Slight	Jack pine-----	68	7	Red pine, eastern white pine, jack pine, white spruce.
						Red pine-----	60	7	
						Quaking aspen-----	68	5	
1970B, 1970C---- Menahga	6S	Slight	Slight	Moderate	Slight	Jack pine-----	60	6	Red pine, jack pine.
						Red pine-----	55	6	
						Quaking aspen-----	70	6	
						Northern red oak----	45	2	
						Bur oak-----	40	2	
1978----- Nokay	5X	Slight	Severe	Slight	Moderate	Quaking aspen-----	68	5	White spruce.
						Sugar maple-----	60	3	
						American basswood---	65	4	
1995B----- Bergkeller	7A	Slight	Slight	Slight	Slight	Jack pine-----	65	7	Jack pine, red pine, northern red oak, bigtooth aspen.
						Red pine-----	68	9	
						Paper birch-----	---	---	
						Bigtooth aspen-----	---	---	
						Bur oak-----	---	---	
1996----- Cromwell	7A	Slight	Slight	Slight	Slight	Red pine-----	58	7	Jack pine, white spruce, eastern white pine.
						Quaking aspen-----	70	6	
						Paper birch-----	60	4	
						Northern red oak----	60	4	
						Balsam fir-----	50	7	
						American basswood---	60	4	
						Eastern white pine---	55	7	
						Jack pine-----	65	7	

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(Only the soils suitable for windbreaks and environmental plantings are listed. The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
7A, 7B----- Hubbard	---	Eastern redcedar, Siberian peashrub, lilac, Siberian crabapple, Manchurian crabapple.	Red pine, jack pine, Russian-olive, green ash.	Eastern white pine, Siberian elm.	---
48----- Hiwood	---	Silver buffaloberry, lilac, Siberian peashrub, Manchurian crabapple, sargent crabapple, Siberian crabapple.	Red pine, Russian-olive, green ash.	Jack pine, eastern white pine, Siberian elm.	---
82B, 82C----- Redeye	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	Eastern white pine, white spruce, red pine, blue spruce, Harbin pear.	Green ash, jack pine.	---
119B, 119C----- Pomroy	---	American cranberrybush, Siberian peashrub, Amur maple, lilac.	Eastern redcedar, red pine, blue spruce, white spruce.	Norway spruce, jack pine, green ash, eastern white pine.	---
126B, 126C----- Graycalm	---	Lilac, Siberian peashrub, eastern redcedar, Manchurian crabapple, Siberian crabapple.	Jack pine, red pine, green ash, Russian-olive.	Siberian elm, eastern white pine.	---
139B----- Huntersville	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	White spruce, blue spruce, Harbin pear.	Eastern white pine, green ash, red pine, jack pine.	---
142----- Nokay	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood, blue spruce.	Eastern redcedar, white spruce.	Norway spruce, jack pine, red pine, eastern white pine, green ash.	---
144B, 144C----- Flak	---	Lilac, Amur maple, American cranberrybush, northern whitecedar, Siberian peashrub.	Manchurian crabapple, eastern redcedar, white spruce.	Eastern white pine, jack pine, green ash.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
146B----- Wabedo	---	American cranberrybush, Amur maple, arrowwood, common chokecherry, gray dogwood, late lilac, northern whitecedar, sargent crabapple, Siberian peashrub.	Hackberry, eastern redcedar, Manchurian crabapple, nannyberry viburnum, Russian-olive, white spruce.	Green ash, jack pine, red pine, Siberian elm, silver maple.	Eastern cottonwood.
147----- Spoonier	---	Lilac, Siberian peashrub, American cranberrybush, redosier dogwood.	White spruce, northern whitecedar, blue spruce, Norway spruce.	Golden willow, eastern white pine, green ash.	Silver maple.
158B----- Zimmerman	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Jack pine, red pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
167B----- Baudette	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	White spruce, eastern redcedar, blue spruce, northern whitecedar, Manchurian crabapple.	Eastern white pine, green ash, red pine.	---
202----- Meehan	---	Lilac, American plum, Siberian peashrub, redosier dogwood.	Eastern redcedar, blue spruce, white spruce.	Eastern white pine, red pine, jack pine, Norway spruce, green ash.	---
204B, 204C, 204E-- Cushing	---	Redosier dogwood, Siberian peashrub, lilac, Amur maple.	Northern whitecedar, eastern redcedar, Manchurian crabapple, blue spruce, white spruce.	Green ash, red pine, eastern white pine.	---
218----- Watab	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, blue spruce, white spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
240A, 240B, 240C-- Warba	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	Northern whitecedar, Manchurian crabapple, eastern redcedar, white spruce, blue spruce.	Green ash, eastern white pine, red pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
243----- Stuntz	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
268B, 268C----- Cromwell	---	Eastern redcedar, Siberian peashrub, lilac, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
292----- Alistad	---	Siberian peashrub, American cranberrybush, redosier dogwood, lilac.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, jack pine, red pine, eastern white pine, green ash.	---
453B, 453C, 453E-- Demontreville	---	American cranberrybush, Siberian peashrub, lilac, Amur maple.	Eastern redcedar, red pine, blue spruce, white spruce.	Eastern white pine, Norway spruce, jack pine, green ash.	---
454B, 454C, 454E-- Mahtomedi	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
458A, 458B, 458C, 458E----- Menahga	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
540----- Seelyeville	---	---	---	Golden willow, white willow.	Imperial Carolina poplar.
564----- Friendship	---	Lilac, Siberian peashrub, Siberian crabapple, eastern redcedar, Manchurian crabapple.	Russian-olive, green ash, jack pine, red pine.	Siberian elm, eastern white pine.	---
620B, 620D----- Cutaway	---	Siberian peashrub, American cranberrybush, Amur maple, lilac.	Blue spruce, red pine, eastern redcedar, white spruce.	Eastern white pine, green ash, Norway spruce, jack pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
625----- Sandwich	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood.	Eastern redcedar, white spruce, blue spruce.	Norway spruce, red pine, jack pine, eastern white pine, green ash.	---
665B, 665C, 665E-- Menahga	---	Eastern redcedar, Manchurian crabapple, Siberian peashrub, lilac, honeysuckle, blue spruce.	Red pine, green ash, Russian- olive, white spruce.	Jack pine, eastern white pine.	---
679B, 679C----- Menahga	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	Eastern white pine, white spruce, green ash, red pine, blue spruce, Harbin pear.	Jack pine-----	---
684----- Bergkeller	---	Eastern redcedar, Siberian elm, lilac, Siberian crabapple, Manchurian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine	---
703----- Paddock	---	Redosier dogwood, American cranberrybush, blue spruce, lilac, Siberian peashrub.	Eastern redcedar, white spruce.	Eastern white pine, jack pine, green ash, Norway spruce, red pine.	---
720B----- Blowers	---	Northern whitecedar, Amur maple, lilac, Siberian peashrub.	White spruce, Russian-olive, Manchurian crabapple.	Green ash, eastern white pine, red pine, silver maple.	---
730A, 730B, 730C, 731A, 731B, 731C- Sanburn	---	Eastern redcedar, Siberian peashrub, lilac, Siberian crabapple, Manchurian crabapple, bur oak, silver buffaloberry.	Red pine, jack pine, green ash, Russian-olive, hackberry.	Eastern white pine	---
732----- Bushville	---	American cranberrybush, Siberian peashrub, lilac.	Eastern redcedar, red pine, blue spruce, white spruce.	Norway spruce, jack pine, eastern white pine, green ash.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
739B----- Wabedo	---	American cranberrybush, Amur maple, arrowwood, common chokecherry, gray dogwood, late lilac, northern whitecedar, sargent crabapple, Siberian peashrub.	Hackberry, eastern redcedar, Manchurian crabapple, nannyberry viburnum, Russian-olive, white spruce.	Green ash, jack pine, red pine, Siberian elm, silver maple.	Eastern cottonwood.
742B, 742C----- Flak	---	Lilac, Amur maple, American cranberrybush, northern whitecedar, Siberian peashrub.	Manchurian crabapple, eastern redcedar, white spruce.	Eastern white pine, jack pine, green ash.	---
750B, 750C----- Pomroy	---	American cranberrybush, Siberian peashrub, Amur maple, lilac.	Eastern redcedar, red pine, blue spruce, white spruce.	Norway spruce, jack pine, green ash, eastern white pine.	---
773B, 773E: Warba-----	---	Siberian peashrub, Amur maple, redosier dogwood, lilac.	Northern whitecedar, Manchurian crabapple, eastern redcedar, white spruce, blue spruce.	Green ash, eastern white pine, red pine.	---
Cromwell-----	---	Eastern redcedar, Siberian peashrub, lilac, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
788: Cathro.					
Seelyeville-----	---	---	---	Golden willow, white willow.	Imperial Carolina poplar.
870B, 870C: Itasca-----	---	Amur maple, redosier dogwood, Siberian peashrub, lilac.	Northern whitecedar, white spruce, blue spruce, Manchurian crabapple, eastern redcedar.	Red pine, green ash, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
870B, 870C: Goodland-----	Lilac, silver buffaloberry, Siberian peashrub.	Siberian crabapple, eastern redcedar, Russian-olive, Manchurian crabapple.	Eastern white pine, green ash, jack pine, red pine.	---	---
928B, 928C, 928E: Demontreville----	---	American cranberrybush, Siberian peashrub, lilac, Amur maple.	Eastern redcedar, red pine, blue spruce, white spruce.	Eastern white pine, Norway spruce, jack pine, green ash.	---
Mahtomedi-----	---	Eastern redcedar, lilac, Siberian peashrub, Manchurian crabapple, Siberian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine, Siberian elm.	---
Cushing-----	---	Redosier dogwood, Siberian peashrub, lilac, Amur maple.	Northern whitecedar, eastern redcedar, Manchurian crabapple, blue spruce, white spruce.	Green ash, red pine, eastern white pine.	---
1151B----- Blowers	---	Northern whitecedar, Amur maple, lilac, Siberian peashrub.	White spruce, Russian-olive, Manchurian crabapple.	Green ash, eastern white pine, red pine, silver maple.	---
1153B----- Huntersville	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	White spruce, blue spruce, Harbin pear.	Eastern white pine, green ash, red pine, jack pine.	---
1155----- Staples	---	Redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, Norway spruce, white spruce, blue spruce, Amur maple.	Green ash, golden willow.	Silver maple.
1157----- Paddock	---	Redosier dogwood, American cranberrybush, blue spruce, lilac, Siberian peashrub.	Eastern redcedar, white spruce.	Eastern white pine, jack pine, green ash, Norway spruce, red pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1160B, 1160C----- Redeye	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	Eastern white pine, white spruce, red pine, blue spruce, Harbin pear.	Green ash, jack pine.	---
1956----- Staples	---	Redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, Norway spruce, white spruce, blue spruce, Amur maple.	Green ash, golden willow.	Silver maple.
1957B----- Friendship	---	Lilac, Siberian peashrub, Siberian crabapple, eastern redcedar, Manchurian crabapple.	Russian-olive, green ash, jack pine, red pine.	Siberian elm, eastern white pine.	---
1970B, 1970C----- Menahga	Honeysuckle-----	Amur maple, lilac, Siberian peashrub.	Eastern white pine, white spruce, green ash, red pine, blue spruce, Harbin pear.	Jack pine-----	---
1978----- Nokay	---	Siberian peashrub, American cranberrybush, lilac, redosier dogwood, blue spruce.	Eastern redcedar, white spruce.	Norway spruce, jack pine, red pine, eastern white pine, green ash.	---
1995B----- Bergkeller	---	Eastern redcedar, Siberian peashrub, lilac, Siberian crabapple, Manchurian crabapple.	Red pine, jack pine, green ash, Russian-olive.	Eastern white pine	---
1996----- Cromwell	---	Eastern redcedar, Siberian peashrub, lilac, Siberian crabapple, Manchurian crabapple, honeysuckle.	Green ash, Russian-olive, white spruce.	Eastern white pine, red pine, jack pine.	---

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
7A----- Hubbard	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: droughty.
7B----- Hubbard	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
48----- Hiwood	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: too sandy, wetness.	Moderate: too sandy.	Moderate: droughty.
82B----- Redeye	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
82C----- Redeye	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
119B----- Pomroy	Moderate: percs slowly, too sandy.	Moderate: too sandy, percs slowly.	Moderate: slope, too sandy, percs slowly.	Moderate: too sandy.	Severe: droughty.
119C----- Pomroy	Moderate: slope, percs slowly.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
126B----- Graycalm	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Severe: droughty.
126C----- Graycalm	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
139B----- Huntersville	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
142----- Nokay	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: small stones, wetness, percs slowly.	Moderate: wetness.	Moderate: small stones, wetness.
144B----- Flak	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight-----	Moderate: droughty.
144C----- Flak	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: droughty, slope.
146B----- Wabedo	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones.	Slight-----	Moderate: droughty.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
147----- Spoonier	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
158B----- Zimmerman	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
167B----- Baudette	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
202----- Meehan	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness, too sandy.	Severe: too acid.
204B----- Cushing	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.
204C----- Cushing	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, slope.
204E----- Cushing	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
217----- Nokasippi	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
218----- Watab	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
240A, 240B----- Warba	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
240C----- Warba	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
243----- Stuntz	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
268B----- Cromwell	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
268C----- Cromwell	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
292----- Alstad	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
453B----- Demontreville	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
453C----- Demontreville	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
453E----- Demontreville	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
454B----- Mahtomedi	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope.	Moderate: too sandy.	Moderate: droughty.
454C----- Mahtomedi	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
454E----- Mahtomedi	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
458A----- Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
458B----- Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
458C----- Menahga	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
458E----- Menahga	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
540----- Seelyville	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
541----- Rifle	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
543----- Markey	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
544----- Cathro	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
549----- Greenwood	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
564----- Friendship	Moderate: too sandy.	Moderate: too sandy.	Moderate: small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
620B----- Cutaway	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
620D----- Cutaway	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
625----- Sandwich	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
665B----- Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
665C----- Menahga	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
665E----- Menahga	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
679B----- Menahga	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
679C----- Menahga	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty.
684----- Bergkeller	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Moderate: droughty.
701----- Runeberg	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
703----- Paddock	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
720B----- Blowers	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Slight-----	Moderate: large stones.
730A, 730B----- Sanburn	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
730C----- Sanburn	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
731A----- Sanburn	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Severe: droughty.
731B----- Sanburn	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Severe: droughty.
731C----- Sanburn	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Severe: droughty.
732----- Bushville	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, too sandy, wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
739B----- Wabedo	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones.	Slight-----	Moderate: droughty.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
742B----- Flak	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight-----	Moderate: droughty.
742C----- Flak	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: droughty, slope.
750B----- Pomroy	Moderate: percs slowly, too sandy.	Moderate: too sandy, percs slowly.	Moderate: slope, too sandy, percs slowly.	Moderate: too sandy.	Severe: droughty.
750C----- Pomroy	Moderate: slope, percs slowly.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
773B: Warba-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Cromwell-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
773E: Warba-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Cromwell-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
788: Cathro-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Seelyeville-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
797: Mooselake-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Lupton-----	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
799: Bowstring-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Seelyeville-----	Severe: flooding, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, flooding.	Severe: wetness, excess humus.	Severe: wetness, flooding, excess humus.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
870B: Itasca-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.
Goodland-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.
870C: Itasca-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Goodland-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
928B: Demontreville-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
Mahtomedi-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope.	Moderate: too sandy.	Moderate: droughty.
Cushing-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.
928C: Demontreville-----	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
Mahtomedi-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
Cushing-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, slope.
928E: Demontreville-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mahtomedi-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1002----- Fluvaquents	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1141----- Runeberg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1151B----- Blowers	Moderate: wetness.	Moderate: wetness.	Moderate: slope, small stones, wetness.	Slight-----	Moderate: large stones.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1153B----- Huntersville	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
1155----- Staples	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
1157----- Paddock	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1160B----- Redeye	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
1160C----- Redeye	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
1943----- Roscommon	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1956----- Staples	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1957B----- Friendship	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
1970B----- Menahga	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Moderate: too sandy.	Moderate: droughty.
1970C----- Menahga	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Moderate: too sandy.	Moderate: droughty, slope.
1978----- Nokay	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: small stones, wetness, percs slowly.	Moderate: wetness.	Moderate: small stones, wetness.
1995B----- Bergkeller	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
1996----- Cromwell	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
7A, 7B----- Hubbard	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
48----- Hiwood	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Fair	Poor.
82B, 82C----- Redeye	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
119B, 119C----- Pomroy	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
126B, 126C----- Graycalm	Poor	Poor	Fair	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
139B----- Huntersville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
142----- Nokay	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Fair.
144B----- Flak	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
144C----- Flak	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
146B----- Wabedo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
147----- Sponser	Poor	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
158B----- Zimmerman	Poor	Poor	Fair	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.
167B----- Baudette	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
202----- Meehan	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
204B----- Cushing	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
204C----- Cushing	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
204E----- Cushing	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
217----- Nokasippi	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
218----- Watab	Fair	Fair	Good	Good	Fair	Fair	Fair	Fair	Good	Fair.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
240A----- Warba	Good	Good	Good	Good	Poor	Very poor.	Very poor.	Good	Good	Very poor.
240B----- Warba	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
240C----- Warba	Fair	Good	Good	Good	Poor	Very poor.	Very poor.	Good	Good	Very poor.
243----- Stuntz	Fair	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair.
268B, 268C----- Cromwell	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
292----- Alstad	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
453B----- Demontreville	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
453C----- Demontreville	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.
453E----- Demontreville	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.
454B, 454C----- Mahtomedi	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
454E----- Mahtomedi	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
458A, 458B, 458C--- Menahga	Poor	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
458E----- Menahga	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
540----- Seelyeville	Very poor.	Fair	Good	Poor	Poor	Good	Good	Fair	Poor	Good.
541----- Rifle	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
543----- Markey	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
544----- Cathro	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
549----- Greenwood	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
564----- Friendship	Poor	Fair	Good	Fair	Good	Poor	Very poor.	Fair	Good	Very poor.
620B----- Cutaway	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
620D----- Cutaway	Poor	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
625----- Sandwich	Poor	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor.
665B, 665C----- Menahga	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
665E----- Menahga	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
679B, 679C----- Menahga	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
684----- Bergkeller	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Fair	Poor.
701----- Runeberg	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
703----- Paddock	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
720B----- Blowers	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
730A, 730B, 730C, 731A, 731B, 731C-- Sanburn	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
732----- Bushville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Poor.
739B----- Wabedo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
742B, 742C----- Flak	Very poor.	Poor	Good	Good	Good	Poor	Very poor.	Poor	Good	Very poor.
750B, 750C----- Pomroy	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
773B: Warba-----	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Cromwell-----	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
773E: Warba-----	Fair	Good	Good	Good	Poor	Very poor.	Very poor.	Good	Good	Very poor.
Cromwell-----	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
788: Cathro-----	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Seelyeville-----	Very poor.	Fair	Good	Poor	Poor	Good	Good	Fair	Poor	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
797: Mooselake-----	Very poor.	Poor	Poor	Poor	Fair	Good	Good	Poor	Poor	Good.
Lupton-----	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
799: Bowstring-----	Very poor.	Poor	Good	Poor	Poor	Good	Good	Poor	Poor	Good.
Seelyeville-----	Very poor.	Fair	Fair	Poor	Poor	Good	Good	Fair	Fair	Good.
870B: Itasca-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Goodland-----	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
870C: Itasca-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Goodland-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
928B: Demontreville----	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Mahtomedi-----	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Cushing-----	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
928C: Demontreville----	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.
Mahtomedi-----	Poor	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Cushing-----	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
928E: Demontreville----	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.
Mahtomedi-----	Very poor.	Poor	Fair	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Cushing-----	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1002----- Fluvaquents	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1141----- Runeberg	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
1151B----- Blowers	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1153B----- Huntersville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1155----- Staples	Poor	Fair	Fair	Good	Fair	Good	Good	Fair	Good	Good.
1157----- Paddock	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Fair.
1160B, 1160C----- Redeye	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1943----- Roscommon	Poor	Poor	Poor	Fair	Fair	Good	Good	Poor	Fair	Good.
1956----- Staples	Poor	Fair	Fair	Good	Fair	Good	Good	Fair	Good	Good.
1957B----- Friendship	Fair	Fair	Good	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
1970B, 1970C----- Menahga	Poor	Fair	Fair	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.
1978----- Nokay	Very poor.	Very poor.	Good	Good	Good	Fair	Poor	Good	Good	Fair.
1995B----- Bergkeller	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Fair	Poor.
1996----- Cromwell	Fair	Good	Good	Fair	Fair	Poor	Poor	Fair	Fair	Poor.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
7A----- Hubbard	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
7B----- Hubbard	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
48----- Hiwood	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: droughty.
82B----- Redeye	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Moderate: droughty.
82C----- Redeye	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
119B----- Pomroy	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: droughty.
119C----- Pomroy	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
126B----- Graycalm	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: droughty.
126C----- Graycalm	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
139B----- Huntersville	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: droughty.
142----- Nokay	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: small stones, wetness.
144B----- Flak	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
144C----- Flak	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
146B----- Wabedo	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: droughty.
147----- Spooner	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
158B----- Zimmerman	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
167B----- Baudette	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
202----- Meehan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Severe: too acid.
204B----- Cushing	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
204C----- Cushing	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
204E----- Cushing	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
217----- Nokasippi	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
218----- Watab	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
240A----- Warba	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
240B----- Warba	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
240C----- Warba	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
243----- Stuntz	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
268B----- Cromwell	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
268C----- Cromwell	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
292----- Alstad	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
453B----- Demontreville	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
453C----- Demontreville	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
453E----- Demontreville	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
454B----- Mahtomedi	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
454C----- Mahtomedi	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
454E----- Mahtomedi	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
458A----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
458B----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
458C----- Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
458E----- Menahga	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
540----- Seelyeville	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
541----- Rifle	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, excess humus.
543----- Markey	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
544----- Cathro	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
549----- Greenwood	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
564----- Friendship	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.
620B----- Cutaway	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
620D----- Cutaway	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
625----- Sandwich	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
665B----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
665C----- Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
665E----- Menahga	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
679B----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
679C----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Severe: slope.	Slight-----	Moderate: droughty.
684----- Bergkeller	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.
701----- Runeberg	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
703----- Paddock	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
720B----- Blowers	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: large stones.
730A----- Sanburn	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
730B----- Sanburn	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
730C----- Sanburn	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
731A----- Sanburn	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Severe: droughty.
731B----- Sanburn	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: droughty.
731C----- Sanburn	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
732----- Bushville	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
739B----- Wabedo	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: droughty.
742B----- Flak	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
742C----- Flak	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
750B----- Pomroy	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: droughty.
750C----- Pomroy	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
773B: Warba-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Cromwell-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
773E: Warba-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Cromwell-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
788: Cathro-----	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Seelyeville-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
797: Mooselake-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Lupton-----	Severe: excess humus, ponding.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
799: Bowstring-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Seelyeville-----	Severe: excess humus, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, wetness, flooding.	Severe: wetness, flooding, excess humus.
870B: Itasca-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
870B: Goodland-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
870C: Itasca-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Goodland-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
928B: Demontreville----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
Mahtomedi-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
Cushing-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
928C: Demontreville----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Mahtomedi-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Cushing-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
928E: Demontreville----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mahtomedi-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1002----- Fluvaquents	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
1141----- Runeberg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1151B----- Blowers	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: large stones.
1153B----- Huntersville	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Moderate: droughty.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1155----- Staples	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1157----- Paddock	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
1160B----- Redeye	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Moderate: droughty.
1160C----- Redeye	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
1943----- Roscommon	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1956----- Staples	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1957B----- Friendship	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.
1970B----- Menahga	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
1970C----- Menahga	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
1978----- Nokay	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: small stones, wetness.
1995B----- Bergkeller	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
1996----- Cromwell	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Moderate: droughty.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
7A, 7B----- Hubbard	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
48----- Hiwood	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
82B----- Redeye	Severe: percs slowly, poor filter.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
82C----- Redeye	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
119B----- Pomroy	Severe: percs slowly.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
119C----- Pomroy	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
126B----- Graycalm	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
126C----- Graycalm	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
139B----- Huntersville	Severe: wetness, percs slowly.	Severe: seepage.	Moderate: wetness, too sandy.	Severe: seepage.	Fair: too sandy, small stones, wetness.
142----- Nokay	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
144B----- Flak	Severe: percs slowly.	Severe: seepage.	Slight-----	Slight-----	Fair: small stones.
144C----- Flak	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
146B----- Wabedo	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones, wetness.
147----- Spoonier	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
158B----- Zimmerman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
167B----- Baudette	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
202----- Meehan	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
204B----- Cushing	Severe: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Fair: small stones.
204C----- Cushing	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
204E----- Cushing	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
217----- Nokasippi	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
218----- Watab	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
240A----- Warba	Severe: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
240B----- Warba	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
240C----- Warba	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
243----- Stuntz	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
268B----- Cromwell	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
268C----- Cromwell	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
292----- Alstad	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
453B----- Demontreville	Severe: percs slowly.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
453C----- Demontreville	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
453E----- Demontreville	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.
454B----- Mahtomedi	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
454C----- Mahtomedi	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
454E----- Mahtomedi	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
458A, 458B----- Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458C----- Menahga	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458E----- Menahga	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
540----- Seelyeville	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
541----- Rifle	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
543----- Markey	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
544----- Cathro	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
549----- Greenwood	Severe: subsides, wetness.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
564----- Friendship	Severe: wetness, poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
620B----- Cutaway	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
620D----- Cutaway	Severe: percs slowly, poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
625----- Sandwich	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
665B----- Menahga	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
665C----- Menahga	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
665E----- Menahga	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
679B----- Menahga	Severe: poor filter.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
679C----- Menahga	Severe: poor filter.	Severe: seepage, slope.	Slight-----	Severe: seepage.	Fair: small stones.
684----- Bergkeller	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
701----- Runeberg	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
703----- Paddock	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
720B----- Blowers	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones, wetness.
730A, 730B----- Sanburn	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
730C----- Sanburn	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
731A, 731B----- Sanburn	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
731C----- Sanburn	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
732----- Bushville	Severe: wetness, percs slowly.	Severe: seepage.	Moderate: wetness.	Severe: seepage.	Fair: wetness.
739B----- Wabedo	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones, wetness.
742B----- Flak	Severe: percs slowly.	Severe: seepage.	Slight-----	Slight-----	Fair: small stones.
742C----- Flak	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
750B----- Pomroy	Severe: percs slowly.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
750C----- Pomroy	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
773B: Warba-----	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Cromwell-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
773E: Warba-----	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: slope.
Cromwell-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
788: Cathro-----	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
788: Seelyeville-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
797: Mooselake-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Lupton-----	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
799: Bowstring-----	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
Seelyeville-----	Severe: subsides, flooding, wetness.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, excess humus.
870B: Itasca-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
Goodland-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
870C: Itasca-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Goodland-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
928B: Demontreville-----	Severe: percs slowly.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
Mahtomedi-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Cushing-----	Severe: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Fair: small stones.
928C: Demontreville-----	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
928C: Mahtomedi-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Cushing-----	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
928E: Demontreville-----	Severe: percs slowly, slope.	Severe: seepage, slope.	Severe: slope.	Severe: seepage, slope.	Poor: slope.
Mahtomedi-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Cushing-----	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1002----- Fluvaquents	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
1141----- Runeberg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1151B----- Blowers	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones, wetness.
1153B----- Huntersville	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Moderate: wetness.	Severe: seepage.	Fair: small stones, wetness.
1155----- Staples	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
1157----- Paddock	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1160B----- Redeye	Severe: percs slowly, poor filter.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
1160C----- Redeye	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1943----- Roscommon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
1956----- Staples	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
1957B----- Friendship	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1970B----- Menahga	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1970C----- Menahga	Severe: percs slowly, poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1978----- Nokay	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1995B----- Bergkeller	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1996----- Cromwell	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
7A, 7B----- Hubbard	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy.
48----- Hiwood	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
82B, 82C----- Redeye	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
119B, 119C----- Pomroy	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
126B, 126C----- Graycalm	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
139B----- Huntersville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
142----- Nokay	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
144B, 144C----- Flak	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
146B----- Wabedo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
147----- Spoonier	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
158B----- Zimmerman	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
167B----- Baudette	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
202----- Meehan	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, too acid.
204B, 204C----- Cushing	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
204E----- Cushing	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
217----- Nokasippi	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
218----- Watab	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
240A, 240B----- Warba	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
240C----- Warba	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
243----- Stuntz	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
268B, 268C----- Cromwell	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
292----- Alstad	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
453B, 453C----- Demontreville	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
453E----- Demontreville	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones, slope.
454B, 454C----- Mahtomedi	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
454E----- Mahtomedi	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
458A, 458B, 458C----- Menahga	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
458E----- Menahga	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
540----- Seelyeville	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
541----- Rifle	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
543----- Markey	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
544----- Cathro	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
549----- Greenwood	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
564----- Friendship	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
620B----- Cutaway	Fair: thin layer.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
620D----- Cutaway	Fair: thin layer, slope.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, slope.
625----- Sandwich	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
665B, 665C----- Menahga	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
665E----- Menahga	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
679B, 679C----- Menahga	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
684----- Bergkeller	Fair: wetness.	Probable-----	Probable-----	Poor: too sandy, small stones.
701----- Runeberg	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
703----- Paddock	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
720B----- Blowers	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
730A, 730B, 730C, 731A, 731B, 731C----- Sanburn	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
732----- Bushville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
739B----- Wabedo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
742B, 742C----- Flak	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
750B, 750C----- Pomroy	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
773B: Warba-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Cromwell-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
773E: Warba-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Cromwell-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
788: Cathro-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Seelyville-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
797: Mooselake-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Lupton-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
799: Bowstring-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Seelyville-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
870B: Itasca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Goodland-----	Good-----	Probable-----	Improbable: too sandy.	Fair: area reclaim, small stones.
870C: Itasca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Goodland-----	Good-----	Probable-----	Improbable: too sandy.	Fair: area reclaim, small stones, slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
928B, 928C: Demontreville-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
Mahtomedi-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
Cushing-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
928E: Demontreville-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones, slope.
Mahtomedi-----	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
Cushing-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
1002----- Fluvaquents	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1141----- Runeberg	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, wetness.
1151B----- Blowers	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1153B----- Huntersville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1155----- Staples	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones, wetness.
1157----- Paddock	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1160B, 1160C----- Redeye	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, small stones.
1943----- Roscommon	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
1956----- Staples	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, small stones, wetness.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1957B----- Friendship	Good-----	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy.
1970B, 1970C----- Menahga	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.
1978----- Nokay	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1995B----- Bergkeller	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones.
1996----- Cromwell	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
7A----- Hubbard	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
7B----- Hubbard	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
48----- Hiwood	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Droughty.
82B----- Redeye	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing---	Droughty, rooting depth.
82C----- Redeye	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing.	Slope, droughty, rooting depth.
119B----- Pomroy	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing, percs slowly.	Droughty, rooting depth.
119C----- Pomroy	Severe: seepage, slope.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
126B----- Graycalm	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
126C----- Graycalm	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
139B----- Huntersville	Severe: seepage.	Severe: seepage, piping.	Frost action, slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
142----- Nokay	Moderate: seepage.	Severe: piping.	Percs slowly, frost action.	Wetness-----	Wetness, percs slowly.	Wetness, rooting depth.
144B----- Flak	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Soil blowing, percs slowly.	Droughty, rooting depth.
144C----- Flak	Severe: slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
146B----- Wabedo	Moderate: seepage, slope.	Severe: seepage, piping.	Percs slowly, slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth, percs slowly.
147----- Spoonier	Moderate: seepage.	Severe: piping, wetness.	Frost action---	Wetness, soil blowing, erodes easily.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
158B----- Zimmerman	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
167B----- Baudette	Moderate: seepage, slope.	Severe: piping.	Frost action, slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
202----- Meehan	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, too acid.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
204B----- Cushing	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope-----	Favorable-----	Favorable.
204C, 204E----- Cushing	Severe: slope.	Severe: thin layer.	Deep to water	Slope-----	Slope-----	Slope.
217----- Nokasippi	Severe: seepage.	Severe: piping, ponding.	Ponding, percs slowly, frost action.	Ponding, droughty, fast intake.	Ponding, soil blowing.	Wetness, droughty, rooting depth.
218----- Watab	Severe: seepage.	Severe: seepage, piping, wetness.	Percs slowly, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
240A----- Warba	Moderate: seepage.	Moderate: wetness.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
240B----- Warba	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
240C----- Warba	Severe: slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
243----- Stuntz	Slight-----	Severe: wetness.	Frost action---	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
268B----- Cromwell	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
268C----- Cromwell	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
292----- Alstad	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Frost action---	Wetness, soil blowing.	Wetness-----	Wetness.
453B----- Demontreville	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing---	Droughty, rooting depth.
453C, 453E----- Demontreville	Severe: seepage, slope.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing.	Slope, droughty, rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
454B----- Mahtomedi	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
454C, 454E----- Mahtomedi	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.
458A----- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
458B----- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
458C, 458E----- Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
540----- Seelyeville	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
541----- Rifle	Severe: seepage.	Severe: excess humus, ponding.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.
543----- Markey	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
544----- Cathro	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
549----- Greenwood	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness-----	Wetness-----	Wetness.
564----- Friendship	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
620B----- Cutaway	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Erodes easily, too sandy.	Erodes easily, droughty.
620D----- Cutaway	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, erodes easily, too sandy.	Slope, erodes easily, droughty.
625----- Sandwich	Severe: seepage.	Severe: wetness.	Favorable-----	Wetness, droughty, fast intake.	Wetness, soil blowing.	Wetness, erodes easily, rooting depth.
665B----- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
665C, 665E----- Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
679B, 679C----- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing---	Droughty, rooting depth.
684----- Bergkeller	Severe: seepage.	Severe: seepage.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
701----- Runeberg	Slight-----	Severe: piping, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, rooting depth, percs slowly.
703----- Paddock	Moderate: seepage.	Severe: piping.	Frost action---	Wetness, percs slowly.	Wetness-----	Wetness, rooting depth.
720B----- Blowers	Moderate: seepage, slope.	Severe: piping.	Frost action, slope, cutbanks cave.	Slope, wetness, soil blowing.	Wetness, too sandy, soil blowing.	Rooting depth.
730A----- Sanburn	Severe: seepage.	Severe: seepage.	Deep to water	Droughty-----	Too sandy, soil blowing.	Droughty.
730B----- Sanburn	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
730C----- Sanburn	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
731A----- Sanburn	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
731B----- Sanburn	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
731C----- Sanburn	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
732----- Bushville	Severe: seepage.	Severe: piping.	Percs slowly---	Wetness, droughty.	Wetness, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
739B----- Wabedo	Moderate: seepage, slope.	Severe: seepage, piping.	Percs slowly, slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth, percs slowly.
742B----- Flak	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Soil blowing, percs slowly.	Droughty, rooting depth.
742C----- Flak	Severe: slope.	Severe: piping.	Deep to water	Slope, droughty, soil blowing.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
750B----- Pomroy	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing, percs slowly.	Droughty, rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
750C----- Pomroy	Severe: seepage, slope.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
773B: Warba-----	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
Cromwell-----	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
773E: Warba-----	Severe: slope.	Moderate: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Cromwell-----	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
788: Cathro-----	Severe: seepage.	Severe: piping, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
Seelyeville-----	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
797: Mooselake-----	Severe: seepage.	Severe: excess humus, ponding.	Ponding, subsides.	Ponding-----	Ponding-----	Wetness.
Lupton-----	Severe: seepage.	Severe: excess humus, wetness.	Subsides, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
799: Bowstring-----	Severe: seepage.	Severe: excess humus, ponding.	Ponding, flooding, subsides.	Ponding, flooding.	Ponding-----	Wetness.
Seelyeville-----	Severe: seepage.	Severe: excess humus, wetness.	Flooding, subsides, frost action.	Wetness, soil blowing, flooding.	Wetness, soil blowing.	Wetness.
870B: Itasca-----	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
Goodland-----	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, rooting depth.	Erodes easily, too sandy.	Erodes easily, rooting depth.
870C: Itasca-----	Severe: slope.	Severe: piping.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
870C: Goodland-----	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, rooting depth.	Slope, erodes easily, too sandy.	Slope, erodes easily, rooting depth.
928B: Demontreville----	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing---	Droughty, rooting depth.
Mahtomedi-----	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
Cushing-----	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
928C, 928E: Demontreville----	Severe: seepage, slope.	Moderate: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing.	Slope, droughty, rooting depth.
Mahtomedi-----	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.
Cushing-----	Severe: slope.	Severe: thin layer.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
1002----- Fluvaquents	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Wetness.
1141----- Runeberg	Slight-----	Severe: piping, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.
1151B----- Blowers	Moderate: seepage, slope.	Severe: piping.	Frost action, slope, cutbanks cave.	Slope, wetness, soil blowing.	Wetness, too sandy, soil blowing.	Rooting depth.
1153B----- Huntersville	Severe: seepage.	Severe: piping.	Frost action, slope.	Slope, wetness, droughty.	Wetness, soil blowing.	Droughty, rooting depth.
1155----- Staples	Severe: seepage.	Severe: piping, wetness.	Percs slowly, frost action, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
1157----- Paddock	Slight-----	Severe: piping.	Frost action---	Wetness, percs slowly.	Wetness-----	Wetness, rooting depth.
1160B----- Redeye	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Soil blowing---	Droughty, rooting depth.
1160C----- Redeye	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing.	Slope, droughty, rooting depth.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1943----- Roscommon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
1956----- Staples	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
1957B----- Friendship	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
1970B----- Menahga	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
1970C----- Menahga	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
1978----- Nokay	Moderate: seepage.	Severe: piping.	Percs slowly, frost action.	Wetness-----	Wetness, percs slowly.	Wetness, rooting depth.
1995B----- Bergkeller	Severe: seepage.	Severe: seepage.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
1996----- Cromwell	Severe: seepage.	Severe: seepage, piping.	Cutbanks cave	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Droughty.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
139B----- Huntersville	0-12	Loamy fine sand	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-30	15-20	NP
	12-24	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-1-b, A-3	0	0-10	85-95	70-95	45-50	20-35	15-20	NP
	24-40	Sandy loam, gravelly sandy loam, clay loam.	SM, SC-SM, SC, CL-ML	A-2-4, A-1-b, A-6	0-10	0-10	85-100	70-95	45-50	20-35	15-25	NP-9
	40-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM, SC	A-2-4, A-1-b	0-10	0-10	85-100	70-95	45-60	15-35	15-25	NP-9
142----- Nokay	0-5	Loam-----	ML, CL-ML	A-4	0	0-2	90-100	70-98	60-90	50-75	20-30	2-7
	5-17	Sandy loam, loam, gravelly sandy loam.	SM, ML	A-2, A-4	0	0-5	85-95	70-95	60-80	25-55	<25	NP-4
	17-32	Sandy loam, loam, gravelly sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4	0	0-5	85-95	70-90	60-80	25-55	20-30	2-7
	32-44	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	85-95	70-90	60-75	25-40	<25	NP-4
	44-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	85-95	70-90	60-75	25-40	<25	NP-4
144B----- Flak	0-4	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
	4-16	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	16-30	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	30-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
144C----- Flak	0-6	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
	6-14	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	14-26	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	26-41	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
	41-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liqui d limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
In				Pct	Pct						Pct	
146B----- Wabedo	0-5	Sandy loam-----	SM, SC-SM A-4	A-2-4, A-4	0	0-2	90-100	80-98	60-85	25-45	15-25	2-7
	5-27	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM A-4, A-1-b	A-2-4, A-4, A-1-b	0	0-4	70-100	60-95	35-75	20-50	0-25	NP-7
	27-47	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM A-1-b	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
	47-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
147----- Spoonier	0-6	Very fine sandy loam.	SM, ML	A-4	0	0	100	100	90-100	35-55	20-40	1-10
	6-14	Loamy very fine sand, very fine sandy loam, loam.	SM, ML, SC, CL	A-4, A-6	0	0	100	100	90-100	35-60	10-40	1-15
	14-22	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-85	20-40	5-15
	22-60	Very fine sandy loam, silt loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	0	100	100	90-100	35-95	16-40	NP-15
158B----- Zimmerman	0-9	Fine sand-----	SM, SP-SM	A-2	0	0	100	95-100	95-100	10-20	15-20	NP
	9-60	Fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	0	100	95-100	95-100	5-20	15-20	NP
167B----- Baudette	0-3	Silt loam-----	ML	A-4	0	0	100	100	95-100	60-90	20-40	1-10
	3-10	Very fine sandy loam, fine sandy loam, silt loam.	SM, ML	A-4	0	0	100	100	75-100	40-90	15-40	NP-10
	10-32	Clay loam, silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	20-50	5-20
	32-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML	A-4	0	0	100	100	95-100	70-100	20-40	1-10

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
											In	
202----- Meehan	0-7	Loamy sand-----	SM	A-2, A-1	0	0	90-100	75-100	40-90	15-30	---	NP
	7-24	Sand, loamy sand, loamy coarse sand.	SM, SP-SM, SP	A-1, A-2, A-3	0	0	90-100	75-100	40-90	3-30	---	NP
	24-60	Sand, coarse sand	SP, SP-SM	A-1, A-3, A-2	0	0	90-100	75-100	40-90	0-5	---	NP
204B----- Cushing	0-10	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	<28	3-9
	10-20	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	20-31	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	31-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20
204C----- Cushing	0-5	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	<28	3-9
	5-17	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	17-49	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	49-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20
204E----- Cushing	0-3	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	<28	3-9
	3-20	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	20-38	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	38-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
In					Pct	Pct					Pct	
217----- Nokasippi	0-10	Loamy fine sand	SM	A-2	0	0	100	95-100	65-90	15-35	---	NP
	10-32	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2, A-3	0	0	95-100	95-100	55-90	5-35	---	NP
	32-41	Sandy loam, loam, gravelly loam.	SM, SC, ML, CL	A-4, A-2-4	0-1	0-5	80-100	70-90	45-85	25-60	<30	NP-10
	41-49	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2-4	0-1	0-10	80-95	70-90	50-85	25-50	<22	NP-4
	49-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2-4	0-1	0-5	80-95	70-90	50-85	25-50	<22	NP-4
219----- Watab	0-5	Loamy sand-----	SM	A-2-4	0	0	100	95-100	75-90	15-25	15-20	NP
	5-30	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-3, A-1-b, A-2-4	0	0	95-100	95-100	10-90	5-35	15-20	NP
	30-38	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-10	80-95	70-90	50-85	25-50	15-20	1-5
	38-41	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-10	80-95	70-90	50-85	25-50	15-20	1-5
	41-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-5	80-95	70-90	50-85	25-50	15-20	1-5
240A----- Warba	0-14	Very fine sandy loam.	ML, SM	A-4	---	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	14-40	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	---	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	40-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	---	0-3	90-100	85-100	70-80	55-75	30-50	10-25
240B----- Warba	0-11	Very fine sandy loam.	ML, SM	A-4	---	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	11-37	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	---	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	37-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	---	0-3	90-100	85-100	70-80	55-75	30-50	10-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
240C----- Warba	0-10	Very fine sandy loam.	ML, SM	A-4	---	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	10-36	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	---	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	36-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	---	0-3	90-100	85-100	70-80	55-75	30-50	10-25
243C----- Stuntz	0-17	Very fine sandy loam.	ML, SM, CL-ML, SC-SM	A-4	0	0-3	98-100	95-100	85-95	45-75	15-25	NP-6
	17-39	Sandy clay loam, clay loam, loam.	CL	A-7, A-6	0	0-3	95-100	85-97	70-85	50-80	30-50	15-25
	39-60	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0	0-5	90-100	85-97	65-85	50-75	30-50	10-20
268B----- Cromwell	0-17	Sandy loam-----	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	17-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
	0-15	Sandy loam-----	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
268C----- Cromwell	15-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
	0-5	Fine sandy loam	ML, SM, CL-ML, SC-SM	A-4, A-2	0	0-3	80-100	75-98	45-85	25-55	<25	2-7
	5-15	Silt loam, loam, fine sandy loam.	ML, CL, SM, SC	A-2, A-4	0	0-3	80-100	75-98	50-98	30-98	<26	2-8
292----- Alstad	15-20	Fine sandy loam, sandy clay loam, loam.	CL, SC, SM, ML	A-4, A-6, A-2	0	0-3	80-100	75-98	50-95	25-75	20-40	5-20
	20-31	Sandy clay loam, sandy loam, loam.	CL, SC	A-6, A-4, A-2, A-7	0	0-3	80-100	75-98	45-95	20-75	25-45	9-25
	31-60	Sandy clay loam, sandy loam, sandy loam.	SC, CL, SM, ML	A-6, A-4, A-2, A-1	0	0-3	80-100	75-98	45-95	20-75	20-45	3-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
											In	
453B----- Demontreville	0-4	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	4-25	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
	25-47	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	47-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8
453C----- Demontreville	0-2	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	2-33	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
	33-50	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	50-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8
453E----- Demontreville	0-2	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	2-36	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
	36-45	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	45-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8
454B----- Mahtomedi	0-2	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	2-6	Sand, coarse sand, loamy coarse sand.	SM, SP-SM sand, loamy	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	6-20	Sand, coarse sand, gravelly sand.	SP-SM, SM sand, gravelly	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	20-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				liquid limit	Plas- ticity index
			Unified	AASHTO			4 10 40 200					
							Pct	Pct				
454C----- Mahtomedi	In				Pct	Pct				Pct		
	0-2	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	2-6	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	6-22	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
454E----- Mahtomedi	22-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
	0-1	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	1-9	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	9-14	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
458A----- Menahga	14-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	3-25	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
458B----- Menahga	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	3-20	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	20-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
458C----- Menahga	3-27	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	27-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	3-27	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
458E----- Menahga	22-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	0-5	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	5-22	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	22-60	Coarse sand, sand	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
540----- Seelyeville	0-20	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	20-60	Muck, mucky peat	PT	A-8	0	0	---	---	---	---	---	---
541----- Rifle	0-11	Mucky peat-----	PT	A-8	0	0	---	---	---	---	---	---
	11-60	Mucky peat-----	PT	A-8	0	0	---	---	---	---	---	---
543----- Markey	0-30	Muck-----	PT	A-8	---	---	---	---	---	---	---	---
	30-60	Fine sand, loamy sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	0	100	75-100	60-75	0-20	---	NP
544----- Cathro	0-15	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	15-40	Sapric material	PT	A-8	0	0	---	---	---	---	---	---
	40-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0	0-5	85-100	75-100	60-100	35-90	20-40	5-20
549----- Greenwood	0-8	Peat-----	PT	A-8	0	0	---	---	---	---	---	---
	8-60	Hemic material, mucky peat.	PT	A-8	0	0	---	---	---	---	---	---
564----- Friendship	0-4	Loamy sand-----	SM, SP-SM	A-1, A-2	0	0	75-100	75-100	40-75	12-30	---	NP
	4-9	Sand, loamy sand, coarse sand.	SP-SM, SM, SP	A-1, A-2, A-3	0	0	75-100	75-100	40-75	3-30	---	NP
	9-37	Sand, coarse sand	SP-SM, SM, SP	A-1, A-3, A-2	0	0	75-100	75-100	40-70	3-15	---	NP
	37-60	Sand, coarse sand	SP-SM, SM, SP	A-1, A-3, A-2	0	0	75-100	75-100	40-70	3-15	---	NP
620B----- Cutaway	0-2	Loamy sand-----	SM, SP-SM	A-2	0	0-3	100	85-100	55-90	10-25	---	NP
	2-27	Loamy sand, sand, coarse sand.	SM, SP-SM	A-2, A-3	0	0-3	100	85-100	50-80	5-20	---	NP
	27-42	Clay loam, loam, sandy loam.	CL, ML	A-7, A-6	0	0-4	95-100	85-95	75-85	60-80	30-45	10-20
	42-60	Loam, clay loam, sandy loam.	CL, ML	A-6, A-4	0	0-4	90-100	85-95	70-80	55-70	30-40	10-20
620D----- Cutaway	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0-3	100	85-100	55-90	10-25	---	NP
	3-31	Loamy sand, sand, coarse sand.	SM, SP-SM	A-2, A-3	0	0-3	100	85-100	50-80	5-20	---	NP
	31-43	Clay loam, loam, sandy loam.	CL, ML	A-7, A-6	0	0-4	95-100	85-95	75-85	60-80	30-45	10-20
	43-60	Loam, clay loam, sandy loam.	CL, ML	A-6, A-4	0	0-4	90-100	85-95	70-80	55-70	30-40	10-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing				Liquid limit	Plas- ticity index
			Unified	AASHTO			sieve number--					
							4	10	40	200		
625----- Sandwick	In				Pct	Pct					Pct	
	0-5	Loamy sand-----	SM	A-2	0	0	95-100	85-100	65-90	15-30	0-14	NP
	5-28	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2	0	0	95-100	85-100	60-90	10-30	0-14	NP
	28-43	Loam, clay loam, sandy loam.	CL, ML	A-6, A-7	---	0-5	90-100	85-100	70-90	55-80	30-45	10-20
	43-60	Loam, clay loam, sandy loam.	CL, ML	A-6	---	0-5	90-100	85-100	70-90	50-80	30-40	10-20
665B----- Menahga	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0-2	95-100	85-100	60-80	10-30	---	NP
	3-30	Loamy sand, sand	SP, SP-SM	A-2, A-3, A-1	0	0-2	95-100	80-100	30-75	0-10	---	NP
	30-60	Coarse sand, sand, loamy sand.	SP, SP-SM	A-3, A-2, A-1	0	0-3	95-100	80-100	30-75	0-10	---	NP
665C----- Menahga	0-5	Loamy sand-----	SM, SP-SM	A-2	0	0-2	95-100	85-100	60-80	10-30	---	NP
	5-25	Loamy sand, sand	SP, SP-SM	A-2, A-3, A-1	0	0-2	95-100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand, loamy sand.	SP, SP-SM	A-3, A-2, A-1	0	0-3	95-100	80-100	30-75	0-10	---	NP
665E----- Menahga	0-3	Loamy sand-----	SM, SP-SM	A-2	0	0-2	95-100	85-100	60-80	10-30	---	NP
	3-20	Loamy sand, sand	SP, SP-SM	A-2, A-3, A-1	0	0-2	95-100	80-100	30-75	0-10	---	NP
	20-60	Coarse sand, sand, loamy sand.	SP, SP-SM	A-3, A-2, A-1	0	0-3	95-100	80-100	30-75	0-10	---	NP
679B----- Menahga	0-3	Loamy sand-----	SM, SP-SM	A-2-4	0	0-1	90-100	80-95	65-80	10-30	---	NP
	3-9	Loamy sand, sand	SM, SP-SM	A-2-4, A-3	0	0-3	85-100	80-95	50-75	5-30	---	NP
	9-54	Sand, loamy sand	SM, SP-SM	A-2-4, A-3	0	0-5	85-100	80-95	50-75	5-30	---	NP
679C----- Menahga	54-60	Sandy loam, loam, silt loam.	SM, SC-SM, SC	A-2-4, A-1-b	0	0-5	85-100	75-95	45-70	15-35	<25	NP-9
	0-3	Loamy sand-----	SM, SP-SM	A-2-4	0	0-1	90-100	80-95	65-80	10-30	---	NP
	3-27	Loamy sand, sand	SM, SP-SM	A-2-4, A-3	0	0-3	85-100	80-95	50-75	5-30	---	NP
	27-35	Sand, loamy sand	SM, SP-SM	A-2-4, A-3	0	0-5	85-100	80-95	50-75	5-30	---	NP
	35-60	Sandy loam, loam, silt loam.	SM, SC-SM, SC	A-2-4, A-1-b	0	0-5	85-100	75-95	45-70	15-35	<25	NP-9

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
			In			Pct					Pct	
684----- Bergkeller	0-5	Sandy loam-----	SM	A-2	0	0-5	85-100	85-100	65-80	25-35	<20	NP
	5-20	Sandy loam, loamy sand, sand.	SM, SP-SM	A-2	0	0-5	85-100	85-100	55-80	10-30	<20	NP
	20-33	Sandy loam, gravelly sandy loam, coarse sandy loam.	SM, SC-SM, GM, GC	A-2	0	0-5	65-95	55-85	35-55	25-35	15-25	3-10
	33-60	Coarse sand, gravelly coarse sand, sand.	SP-SM, SM	A-2, A-3	0	0-5	65-95	55-85	50-70	5-15	---	NP
701----- Runeberg	0-3	Mucky loam-----	ML, CL	A-4, A-6	0-1	2-5	95-100	90-95	80-90	50-80	30-40	5-15
	3-26	Sandy loam-----	SM, SC, SC-SM	A-2, A-4	0-1	5-10	85-95	80-95	60-75	30-45	15-25	3-10
	26-60	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0-1	5-10	85-95	80-95	60-75	30-45	15-25	3-8
703----- Paddock	0-7	Loam-----	ML, CL	A-4, A-6	0	0-5	95-100	90-95	80-90	55-80	30-40	7-15
	7-20	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0-10	85-95	85-90	60-75	25-40	<20	1-5
	20-45	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0-10	85-95	80-95	60-75	25-45	<25	2-10
	45-60	Sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0-10	85-90	80-90	60-75	25-40	<20	2-8
720B----- Blowers	0-9	Sandy loam-----	SM, SC-SM	A-2, A-4	---	0-10	85-100	85-100	60-80	30-40	20-30	1-7
	9-25	Sandy loam-----	SM, SC-SM	A-2, A-4	---	0-10	85-95	85-90	60-75	30-40	<20	1-5
	25-32	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	85-95	60-75	30-40	<25	2-10
	32-49	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	80-95	60-75	30-40	<25	2-10
730A----- Sanburn	49-60	Sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	80-90	60-75	25-40	<25	2-10
	0-3	Sandy loam-----	SM, SC-SM	A-2-4, A-4	0	0-5	85-100	80-100	65-85	25-40	15-26	NP-6
	3-16	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	16-24	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
24-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP	

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
730B----- Sanburn	In				Pct	Pct					Pct	
	0-5	Sandy loam-----	SM, SC-SM	A-2-4, A-4	0	0-5	85-100	80-100	65-85	25-40	15-26	NP-6
	5-16	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	16-21	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
	21-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP
730C----- Sanburn	0-7	Sandy loam-----	SM, SC-SM	A-2-4, A-4	0	0-5	85-100	80-100	65-85	25-40	15-26	NP-6
	7-16	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	16-23	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
	23-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP
731A----- Sanburn	0-6	Loamy sand-----	SM, SP-SM	A-2-4	0	0-5	80-100	80-100	50-75	10-20	15-23	NP-2
	6-15	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	15-26	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
	26-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP
731B----- Sanburn	0-8	Loamy sand-----	SM, SP-SM	A-2-4	0	0-5	80-100	80-100	50-75	10-20	15-23	NP-2
	8-19	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	19-30	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
	30-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
					Pct	Pct					Pct	
731C----- Sanburn	In										Pct	
	0-8	Loamy sand-----	SM, SP-SM	A-2-4	0	0-5	80-100	80-100	50-75	10-20	15-23	NP-2
	8-14	Loamy sand, sandy loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-2-4	0-1	0-5	80-100	80-100	55-85	15-40	15-26	NP-8
	14-22	Sandy loam, gravelly sandy loam, fine sandy loam.	SM, SC, SC-SM	A-2, A-4, A-6	0-1	0-10	75-100	65-90	45-90	10-40	15-31	NP-13
	22-60	Sand, coarse sand, gravelly sand.	SP	A-1	0-1	0-10	65-90	45-90	15-50	1-5	---	NP
732----- Bushville	0-5	Loamy sand-----	SM	A-2-4	0	0	100	95-100	55-70	15-30	---	NP
	5-27	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-2-4	0	0	100	95-100	55-85	10-25	---	NP
	27-38	Fine sandy loam, sandy loam.	SC-SM, SC	A-4	0-2	0-3	85-95	80-95	55-75	40-50	15-22	4-9
	38-48	Sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2-4	0-2	0-3	85-95	80-95	50-70	25-50	15-22	NP-6
	48-60	Sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2-4	0-2	0-3	85-95	80-95	50-70	25-50	15-22	NP-6
739B----- Wabedo	0-4	Sandy loam-----	SM, SC-SM	A-2-4, A-4	0	0-2	90-100	80-98	60-85	25-45	15-25	2-7
	4-25	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4, A-1-b	0	0-4	70-100	60-95	35-75	20-50	0-25	NP-7
	25-41	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
	41-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
	0-4	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
742B----- Flak	4-13	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	13-22	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	22-41	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
	41-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
											Pct	
742C----- Flak	In										Pct	
	0-4	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
	4-15	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	15-24	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	24-30	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
750B----- Pcmroy	30-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
	0-4	Loamy sand-----	SM	A-2, A-1-b	0	0	100	95-100	45-80	15-35	---	NP
	4-14	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-2, A-1-b	0	0	100	95-100	45-80	10-35	---	NP
	14-24	Fine sandy loam, sandy loam.	SM	A-4, A-2	0-1	0-10	85-95	75-85	50-70	25-45	15-22	NP-4
	24-42	Sandy loam, fine sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	75-85	50-70	25-40	15-22	NP-4
750C----- Pcmroy	42-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	70-90	50-70	25-40	15-22	NP-4
	0-3	Loamy sand-----	SM	A-2, A-1-b	0	0	100	95-100	45-80	15-35	---	NP
	3-7	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-2, A-1-b	0	0	100	95-100	45-80	10-35	---	NP
	7-34	Fine sandy loam, sandy loam.	SM	A-4, A-2	0-1	0-10	85-95	75-85	50-70	25-45	15-22	NP-4
	34-40	Sandy loam, fine sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	75-85	50-70	25-40	15-22	NP-4
773B: Warba-----	40-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	70-90	50-70	25-40	15-22	NP-4
	0-17	Very fine sandy loam.	ML, SM	A-4	---	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	17-36	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	---	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	36-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	---	0-3	90-100	85-100	70-80	55-75	30-50	10-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
773B: Cromwell-----	0-16	Sandy loam-----	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	16-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
773E: Warba-----	0-11	Very fine sandy loam.	ML, SM	A-4	---	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	11-45	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	---	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	45-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	---	0-3	90-100	85-100	70-80	55-75	30-50	10-25
Cromwell-----	0-23	Sandy loam-----	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	23-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
788: Cathro-----	0-32	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	32-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0	0-5	85-100	75-100	60-100	35-90	20-40	5-20
Seelyeville-----	0-12	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	12-60	Muck, mucky peat	PT	A-8	0	0	---	---	---	---	---	---
797: Mooselake-----	0-8	Mucky peat-----	PT	A-8	0	0	---	---	---	---	---	---
	8-60	Mucky peat-----	PT	A-8	0	0	---	---	---	---	---	---
Lupton-----	0-25	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	25-60	Sapric material--	PT	A-8	0	0	---	---	---	---	---	---
799: Bowstring-----	0-32	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	32-40	Stratified sand to fine sandy loam.	SP-SM, SM, SC-SM	A-2	0	0	100	100	50-85	10-35	15-20	NP-5
	40-60	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
Seelyeville-----	0-10	Muck-----	PT	A-8	0	0	---	---	---	---	---	---
	10-60	Muck, sapric material.	PT	A-8	0	0	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
In				Pct	Pct						Pct	
870C: Goodland-----	0-6	Silt loam-----	ML, CL-ML	A-4	0	0	95-100	95-100	85-100	50-90	15-25	2-5
	6-40	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4	0	0-3	95-100	85-95	45-75	35-60	20-30	2-10
	40-46	Gravelly loamy coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SC-SM	A-2, A-1	0	0-10	70-100	65-100	35-50	5-30	15-20	NP-5
	46-60	Sand, gravelly coarse sand, gravelly sand.	SP, SW, SP-SM	A-1	0	0-10	80-100	75-100	35-50	2-10	---	NP
928B: Demontreville---	0-2	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	2-22	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
	22-39	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	39-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8
Mahtomedi-----	0-2	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	2-9	Sand, coarse sand, loamy coarse sand.	SM, SP-SM A-3	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	9-16	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	16-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
Cushing-----	0-3	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0	0-7	75-100	75-100	45-95	20-65	<25	2-7
	3-19	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	19-32	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	32-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO								
							4	10	40	200		
928C: Dumontreville---	In				Pct	Pct					Pct	
	0-1	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	1-31	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
	31-46	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	46-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8
Mahtomedi-----	0-2	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	2-4	Sand, coarse sand, loamy coarse sand.	SM, SP-SM SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	4-19	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	19-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
	0-3	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0	0-7	75-100	75-100	45-95	20-65	<25	2-7
Cushing-----	3-21	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	21-40	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	40-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20
	0-4	Loamy sand-----	SM	A-2	0	0-5	90-100	85-100	65-80	20-35	<20	NP
	4-33	Loamy sand, sand, fine sand.	SP, SP-SM, SM	A-2, A-3	0-1	0-5	90-100	85-100	60-80	2-35	<20	NP
928E: Dumontreville---	33-42	Sandy loam, sandy clay loam, gravelly sandy loam.	SC, SM, CL, ML	A-2, A-4	0-1	0-5	80-100	70-90	55-70	20-55	15-25	3-10
	42-60	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM, SC-SM	A-2, A-4	0-1	0-5	80-100	70-90	45-65	25-45	15-25	3-8

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO								
			In			Pct	Pct	4	10	40	200	
928E: Mahtomedi-----	0-3	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	3-23	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	23-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
	0-7	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0	0-7	75-100	75-100	45-95	20-65	<25	2-7
Cushing-----	7-16	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	<23	NP-6
	16-49	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	49-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	<34	2-20
	0-12	Silt loam-----	ML, SM	A-4	0	0	100	90-100	75-100	45-80	15-35	NP-10
1002----- Fluvaquents	12-60	Stratified loamy sand to silt loam.	ML, CL, SM, SC	A-2, A-4, A-6, A-7	0	0	95-100	85-100	45-95	20-80	20-45	3-20
	0-10	Loam-----	ML, CL	A-4, A-6	0	2-5	95-100	90-95	80-90	50-80	30-40	5-15
1141----- Runeberg	10-27	Sandy loam, gravelly sandy loam, loam.	SM, SC, SC-SM	A-2, A-4	0-1	5-10	85-95	70-95	60-75	30-45	15-25	3-10
	27-60	Sandy loam, gravelly sandy loam.	SM, SC-SM, SC	A-2, A-4	0-1	5-10	85-95	70-95	60-75	30-45	15-25	3-8
1151B----- Blowers	0-5	Sandy loam-----	SM, SC-SM	A-2, A-4	---	0-10	85-100	85-100	60-80	30-40	20-30	1-7
	5-17	Sandy loam, loamy sand.	SM, SC-SM	A-2, A-4	---	0-10	85-95	85-90	60-75	30-40	<20	1-5
	17-23	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	85-95	60-75	30-40	<25	2-10
	23-44	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	80-95	60-75	30-40	<25	2-10
44-60	Sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	80-90	60-75	25-40	<25	NP-10	

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
1153B----- Huntersville	In											Pct
	0-14	Loamy sand-----	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-20	<20	NP
	14-26	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-1-b, A-3	---	0-10	85-95	70-90	45-50	20-35	<20	NP
	26-58	Sandy loam, gravelly sandy loam.	SM, SC-SM, SC	A-2-4, A-1-b	---	0-10	85-100	70-95	45-50	20-35	<25	NP-9
	58-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM, SC	A-2-4, A-1-b	---	0-10	85-100	70-95	45-60	15-35	<25	NP-9
1155----- Staples	0-4	Loamy sand-----	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-30	<20	NP-4
	4-27	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-3, A-2-4, A-1-b	0	0-10	85-95	70-95	30-65	5-15	<20	NP-4
	27-35	Sandy loam, gravelly sandy loam.	SM, SC, SC-SM	A-2-4, A-1-b	0	0-10	85-95	70-95	45-67	20-35	<25	NP-9
	35-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM, SC	A-2-4, A-1-b	0	0-10	85-95	70-95	45-67	20-35	<25	NP-9
	0-7	Loam-----	ML, CL	A-4, A-6	---	0-5	95-100	90-95	80-90	55-80	30-40	7-15
1157----- Paddock	7-20	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	---	0-10	85-95	80-90	60-75	25-40	<20	1-5
	20-41	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	---	0-10	85-95	80-95	60-75	25-45	<25	2-10
	41-60	Sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	---	0-10	85-90	80-90	60-75	25-40	<20	2-8
	0-6	Loamy sand-----	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-30	<20	NP-4
	6-15	Loamy sand, loamy fine sand, sand.	SM	A-2-4	0	0	90-100	80-95	65-80	15-30	<20	NP-4
1160B----- Redeye	15-33	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-3, A-1-b	0	0-10	85-95	70-90	30-65	5-15	<20	NP-4
	33-55	Sandy loam, gravelly sandy loam.	SM, SC, SC-SM	A-2-4, A-2-6, A-1-b	0	0-10	85-100	70-95	45-70	15-35	<25	NP-12
	55-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SC-SM	A-2-4, A-1-b	0	0-10	85-100	70-95	45-70	15-35	<25	NP-9

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
					In						Pct	
1160C----- Redeye	0-7	Loamy sand-----	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-30	<20	NP-4
	7-14	Loamy sand, loamy fine sand, sand.	SM	A-2-4	0	0	90-100	80-95	65-80	15-30	<20	NP-4
	14-27	Loamy sand, sand, gravelly loamy sand.	SM, SP-SM	A-2-4, A-3, A-1-b	0	0-10	85-95	70-90	30-65	5-15	<20	NP-4
	27-44	Sandy loam, gravelly sandy loam.	SM, SC, SC-SM	A-2-4, A-2-6, A-1-b	0	0-10	85-100	70-95	45-70	15-35	<25	NP-12
	44-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC, SC-SM	A-2-4, A-1-b	0	0-10	85-100	70-95	45-70	15-35	<25	NP-9
1943----- Roscommon	0-6	Loamy sand-----	SM, SP-SM, SC-SM	A-2, A-1-b	0	0	95-100	85-100	40-85	10-35	<23	NP-6
	6-60	Sand, loamy sand, coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	0	95-100	85-100	40-75	0-30	<20	NP-4
1956----- Staples	0-7	Loamy sand-----	SM, SP-SM	A-2-4	0	0	90-100	80-95	65-80	10-30	0-20	NP-4
	7-36	Loamy sand, sand, loamy fine sand.	SM, SP-SM	A-3, A-2-4, A-1-b	0	0-10	75-95	75-95	30-65	5-15	0-20	NP-4
	36-44	Sandy loam, gravelly sandy loam, clay loam.	SM, SC, SC-SM, CL-ML	A-2-4, A-1-b, A-6	0	0-10	85-95	70-95	45-67	20-35	0-25	NP-9
	44-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM, SC	A-2-4, A-1-b	0	0-10	85-95	70-95	45-67	20-35	0-25	NP-9
1957B----- Friendship	0-8	Loamy sand-----	SP-SM, SM	A-1, A-2	0	0	75-100	75-100	40-75	12-30	---	NP
	8-48	Sand, fine sand, loamy sand.	SP-SM, SM, SP	A-1, A-2, A-3	0	0	75-100	75-100	40-75	3-30	---	NP
	48-60	Sandy loam, loam	SC, SC-SM	A-4, A-2	---	0-10	90-100	70-100	45-70	25-40	20-30	4-10
1970B----- Menahga	0-4	Loamy sand-----	SM, SP-SM	A-2-4	0	0-1	90-100	80-95	65-80	10-30	---	NP
	4-9	Sand, coarse sand, loamy coarse sand.	SM, SC-SM, SP-SM	A-1, A-2, A-3	0	0-2	90-100	75-90	30-75	5-15	---	NP
	9-49	Sand, loamy sand	SM, SP-SM	A-2-4, A-3	0	0-5	85-100	80-95	50-75	5-30	---	NP
	49-60	Sandy loam, loamy sand.	SM, SC-SM, SC	A-2-4, A-1-b	0	0-5	85-100	75-95	45-70	15-35	<25	NP-9

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
7A----- Hubbard	0-16	4-10	1.45-1.60	6.0-20	0.08-0.12	5.1-7.3	Low-----	0.15	5	2	2-5
	16-34	1-5	1.55-1.65	6.0-20	0.03-0.07	5.1-7.3	Low-----	0.15			
	34-60	0-5	1.55-1.65	6.0-20	0.03-0.07	5.6-7.8	Low-----	0.15			
7B----- Hubbard	0-19	4-10	1.45-1.60	6.0-20	0.08-0.12	5.1-7.3	Low-----	0.15	5	2	2-5
	19-45	1-5	1.55-1.65	6.0-20	0.03-0.07	5.1-7.3	Low-----	0.15			
	45-60	0-5	1.55-1.65	6.0-20	0.03-0.07	5.6-7.8	Low-----	0.15			
48----- Hiwood	0-5	2-10	1.40-1.60	6.0-20	0.08-0.12	4.5-6.0	Low-----	0.17	5	2	.5-2
	5-30	1-10	1.55-1.70	6.0-20	0.07-0.10	5.1-6.0	Low-----	0.15			
	30-60	1-10	1.55-1.70	6.0-20	0.05-0.08	5.6-7.8	Low-----	0.15			
82B----- Redeye	0-3	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	1-3
	3-18	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	18-26	2-6	1.45-1.65	6.0-20	0.07-0.10	5.6-6.5	Low-----	0.15			
	26-52	6-18	1.65-1.80	0.2-0.6	0.11-0.13	5.1-7.3	Low-----	0.28			
	52-60	5-14	1.80-2.00	0.00-0.06	0.0-0.04	6.6-8.4	Low-----	0.28			
82C----- Redeye	0-4	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	1-3
	4-7	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	7-31	2-6	1.45-1.65	6.0-20	0.07-0.10	5.6-6.5	Low-----	0.15			
	31-48	6-18	1.65-1.80	0.2-0.6	0.11-0.13	5.1-7.3	Low-----	0.28			
	48-60	5-14	1.80-2.00	0.00-0.06	0.0-0.04	6.6-8.4	Low-----	0.28			
119B----- Pomroy	0-4	5-12	1.40-1.50	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	4	2	.5-1
	4-24	2-10	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	24-31	6-18	1.65-1.90	0.2-0.6	0.0-0.08	5.1-6.5	Low-----	0.24			
	31-42	5-18	1.75-1.90	<0.2	0.0-0.08	5.6-7.3	Low-----	0.24			
	42-60	5-18	1.80-2.00	<0.6	0.0-0.04	5.6-7.3	Low-----	0.24			
119C----- Pomroy	0-3	5-12	1.40-1.50	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	4	2	.5-1
	3-34	2-10	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	34-40	6-18	1.65-1.90	0.2-0.6	0.0-0.08	5.1-6.5	Low-----	0.24			
	40-60	5-18	1.80-2.00	<0.6	0.0-0.04	5.6-7.3	Low-----	0.24			
126B----- Graycalm	0-3	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-16	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	16-52	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
	52-60	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low-----	0.10			
126C----- Graycalm	0-4	0-10	1.30-1.55	6.0-20	0.06-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	4-27	0-15	1.25-1.60	6.0-20	0.05-0.10	4.5-7.3	Low-----	0.10			
	27-50	0-10	1.50-1.65	6.0-20	0.04-0.09	4.5-7.3	Low-----	0.10			
	50-60	0-10	1.50-1.65	6.0-20	0.04-0.06	5.6-8.4	Low-----	0.10			
139B----- Huntersville	0-12	2-6	1.45-1.60	6.0-20	0.10-0.12	6.1-7.3	Low-----	0.17	4	2	1-3
	12-24	2-6	1.45-1.60	6.0-20	0.04-0.10	6.1-7.3	Low-----	0.15			
	24-40	6-35	1.65-1.80	0.2-0.6	0.11-0.13	6.1-7.3	Low-----	0.20			
	40-60	6-15	1.80-2.00	0.00-0.2	0.0-0.04	6.6-7.8	Low-----	0.20			
142----- Nokay	0-5	6-18	1.30-1.50	0.6-2.0	0.18-0.22	4.5-5.5	Low-----	0.32	4	5	3-8
	5-17	5-15	1.45-1.70	0.6-6.0	0.12-0.19	4.5-5.5	Low-----	0.28			
	17-32	8-18	1.45-1.75	0.6-2.0	0.12-0.19	5.1-6.5	Low-----	0.28			
	32-44	4-18	1.75-1.90	<0.2	0.0-0.08	5.6-7.3	Low-----	0.28			
	44-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		Pct
	In	Pct	g/cc	In/hr	In/in	pH					
144B----- Flak	0-4	5-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.5	Low-----	0.28	4	3	.5-2
	4-16	5-18	1.45-1.70	2.0-6.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	16-30	8-18	1.45-1.80	0.6-2.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	30-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
144C----- Flak	0-6	5-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.5	Low-----	0.28	4	3	.5-2
	6-14	5-18	1.45-1.70	2.0-6.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	14-26	8-18	1.45-1.80	0.6-2.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	26-41	4-18	1.75-1.90	<0.2	0.0-0.06	5.1-7.3	Low-----	0.28			
	41-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
146B----- Wabedo	0-5	8-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.0	Low-----	0.28	4	3	.5-4
	5-27	5-18	1.45-1.80	0.6-2.0	0.12-0.16	4.5-6.5	Low-----	0.28			
	27-47	4-18	1.75-1.90	0.06-0.2	0.03-0.08	5.1-7.3	Low-----	0.28			
	47-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.1-7.3	Low-----	0.28			
147----- Spoonier	0-6	5-18	1.30-1.45	2.0-6.0	0.20-0.22	5.6-7.8	Low-----	0.37	5	3	2-4
	6-14	3-18	1.35-1.55	0.6-6.0	0.17-0.19	5.6-7.8	Low-----	0.37			
	14-22	18-35	1.30-1.50	0.6-2.0	0.17-0.22	6.1-7.8	Low-----	0.37			
	22-60	5-32	1.40-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low-----	0.37			
158B----- Zimmerman	0-9	2-5	1.45-1.65	6.0-20	0.07-0.09	5.1-6.5	Low-----	0.17	5	1	.5-1
	9-60	2-10	1.50-1.70	6.0-20	0.06-0.10	5.1-7.3	Low-----	0.17			
167B----- Baudette	0-3	10-27	1.20-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.37	5	6	1-4
	3-10	5-27	1.30-1.50	0.6-2.0	0.14-0.20	5.6-7.3	Low-----	0.37			
	10-32	18-35	1.25-1.45	0.6-2.0	0.17-0.24	5.6-7.8	Moderate----	0.37			
	32-60	5-27	1.30-1.60	0.6-2.0	0.17-0.22	7.4-8.4	Low-----	0.37			
202----- Meehan	0-7	4-10	1.35-1.65	2.0-6.0	0.10-0.12	3.5-7.3	Low-----	0.17	5	2	.5-3
	7-24	4-9	1.60-1.70	>6.0	0.06-0.11	3.5-6.5	Low-----	0.15			
	24-60	1-4	1.60-1.70	>6.0	0.02-0.07	5.1-7.3	Low-----	0.15			
204B----- Cushing	0-10	6-18	1.35-1.65	0.6-2.0	0.16-0.24	5.1-7.8	Low-----	0.32	5	5	1-3
	10-20	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	20-31	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	31-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			
204C----- Cushing	0-5	6-18	1.35-1.65	0.6-2.0	0.16-0.24	5.1-7.8	Low-----	0.32	5	5	1-3
	5-17	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	17-49	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	49-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			
204E----- Cushing	0-3	6-18	1.35-1.65	0.6-2.0	0.16-0.24	5.1-7.8	Low-----	0.32	5	5	1-3
	3-20	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	20-38	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	38-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			
217----- Nokasippi	0-10	3-12	1.45-1.55	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.17	4	2	1-10
	10-32	1-12	1.44-1.65	6.0-20	0.06-0.12	4.5-7.3	Low-----	0.17			
	32-41	3-18	1.55-1.75	0.6-6.0	0.11-0.18	4.5-7.3	Low-----	0.17			
	41-49	5-16	1.75-1.90	<0.2	0.0-0.08	4.5-7.3	Low-----	0.17			
	49-60	5-16	1.80-2.00	<0.06	0.0-0.04	5.1-7.3	Low-----	0.17			
218----- Watab	0-5	3-12	1.40-1.50	6.0-20	0.10-0.12	5.1-6.0	Low-----	0.17	4	2	.5-2
	5-30	1-10	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	30-38	5-16	1.55-1.90	0.6-6.0	0.08-0.12	5.1-6.5	Low-----	0.28			
	38-41	6-16	1.75-1.90	0.06-0.2	0.03-0.08	5.6-7.3	Low-----	0.28			
	41-60	6-16	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
240A----- Warba	0-14	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----	0.20	5	3	1-3
	14-40	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate----	0.32			
	40-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate----	0.32			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
240B----- Warba	0-11	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----	0.20	5	3	1-3
	11-37	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate----	0.32			
	37-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate----	0.32			
240C----- Warba	0-10	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----	0.20	5	3	1-3
	10-36	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate----	0.32			
	36-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate----	0.32			
243----- Stuntz	0-17	5-15	1.10-1.40	2.0-6.0	0.18-0.23	4.5-6.5	Low-----	0.28	5	3	1-3
	17-39	20-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.8	Moderate----	0.28			
	39-60	20-32	1.50-1.70	0.2-0.6	0.16-0.19	6.6-8.4	Low-----	0.28			
268B----- Cromwell	0-17	5-18	1.20-1.40	0.6-2.0	0.16-0.18	4.5-6.0	Low-----	0.20	3	3	.5-2
	17-60	0-8	1.35-1.60	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.05			
268C----- Cromwell	0-15	5-18	1.20-1.40	0.6-2.0	0.16-0.18	4.5-6.0	Low-----	0.20	3	3	.5-2
	15-60	0-8	1.35-1.60	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.05			
292----- Alstad	0-5	7-14	1.50-1.60	0.6-2.0	0.13-0.18	5.1-7.3	Low-----	0.24	5	3	1-3
	5-15	6-16	1.55-1.65	0.6-2.0	0.13-0.22	4.5-7.3	Low-----	0.32			
	15-20	11-30	1.55-1.70	0.6-2.0	0.13-0.21	5.1-7.3	Low-----	0.32			
	20-31	18-35	1.55-1.70	0.6-2.0	0.13-0.19	5.1-7.8	Low-----	0.32			
	31-60	8-35	1.60-1.80	0.2-0.6	0.09-0.19	5.6-8.4	Low-----	0.32			
453B----- Demontreville	0-4	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	4-25	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	25-47	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	47-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
453C----- Demontreville	0-2	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	2-33	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	33-50	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	50-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
453E----- Demontreville	0-2	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	2-36	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	36-45	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	45-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
454B----- Mahtomedi	0-2	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	2-6	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	6-20	0-10	1.45-1.75	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.05			
	20-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
454C----- Mahtomedi	0-2	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	2-6	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	6-22	0-10	1.45-1.75	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.05			
	22-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
454E----- Mahtomedi	0-1	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	1-9	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	9-14	0-10	1.45-1.75	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.05			
	14-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
458A----- Menahga	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-25	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	25-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low-----	0.15			
458B----- Menahga	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-20	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	20-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low-----	0.15			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
458C----- Menahga	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-27	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	27-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low-----	0.15			
458E----- Menahga	0-5	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	5-22	0-5	1.50-1.65	6.0-20	0.05-0.07	4.5-6.5	Low-----	0.15			
	22-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-7.8	Low-----	0.15			
540----- Seelyeville	0-20	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	---	3	2	25-99
	20-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	---			
541----- Rifle	0-11	---	0.20-0.35	0.6-6.0	0.48-0.58	4.5-7.3	-----	---	5	5	>75
	11-60	---	0.08-0.20	0.6-6.0	0.48-0.58	4.5-7.3	-----	---			
543----- Markey	0-30	---	0.15-0.45	0.2-6.0	0.35-0.45	4.5-7.8	-----	---	4	2	55-85
	30-60	0-10	1.40-1.65	6.0-20	0.03-0.08	5.6-8.4	Low-----	0.15			
544----- Cathro	0-15	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-----	---	5	2	60-85
	15-40	---	0.15-0.30	0.2-6.0	0.35-0.45	4.5-7.8	-----	---			
	40-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low-----	0.20			
549----- Greenwood	0-8	---	0.30-0.40	>6.0	0.55-0.65	3.6-4.4	-----	---	5	7	55-75
	8-60	---	0.10-0.25	0.6-6.0	0.45-0.55	3.6-4.4	-----	---			
564----- Friendship	0-4	3-8	1.50-1.65	6.0-20	0.08-0.12	4.5-7.3	Low-----	0.17	5	2	.5-2
	4-9	2-7	1.35-1.65	6.0-20	0.05-0.11	4.5-6.5	Low-----	0.15			
	9-37	0-4	1.50-1.65	6.0-20	0.05-0.08	4.5-7.3	Low-----	0.15			
	37-60	0-4	1.50-1.70	6.0-20	0.04-0.07	5.1-7.8	Low-----	0.15			
620B----- Cutaway	0-2	0-8	1.45-1.55	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	5	2	.5-2
	2-27	0-8	1.50-1.60	6.0-20	0.06-0.11	5.1-6.5	Low-----	0.17			
	27-42	18-35	1.60-1.75	0.2-2.0	0.12-0.19	5.1-7.8	Moderate----	0.37			
	42-60	18-30	1.60-1.75	0.2-2.0	0.12-0.19	6.1-8.4	Low-----	0.37			
620D----- Cutaway	0-3	0-8	1.45-1.55	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	5	2	.5-2
	3-31	0-8	1.50-1.60	6.0-20	0.06-0.11	5.1-6.5	Low-----	0.17			
	31-43	18-35	1.60-1.75	0.2-2.0	0.12-0.19	5.1-7.8	Moderate----	0.37			
	43-60	18-30	1.60-1.75	0.2-2.0	0.12-0.19	6.1-8.4	Low-----	0.37			
625----- Sandwich	0-5	0-8	1.45-1.55	6.0-20	0.08-0.10	5.1-6.5	Low-----	0.17	4	2	.5-2
	5-28	0-8	1.50-1.60	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	28-43	18-35	1.65-1.80	0.2-0.6	0.10-0.16	5.6-7.3	Moderate----	0.32			
	43-60	18-30	1.65-1.80	0.2-0.6	0.02-0.10	6.6-8.4	Low-----	0.32			
665B----- Menahga	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-30	2-5	1.50-1.65	6.0-20	0.07-0.09	4.5-6.5	Low-----	0.15			
	30-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low-----	0.15			
665C----- Menahga	0-5	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	5-25	2-5	1.50-1.65	6.0-20	0.07-0.09	4.5-6.5	Low-----	0.15			
	25-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low-----	0.15			
665E----- Menahga	0-3	2-10	1.20-1.50	6.0-20	0.10-0.12	4.5-6.5	Low-----	0.15	5	2	.5-2
	3-20	2-5	1.50-1.65	6.0-20	0.07-0.09	4.5-6.5	Low-----	0.15			
	20-60	0-5	1.50-1.65	6.0-20	0.05-0.07	5.6-6.5	Low-----	0.15			
679B----- Menahga	0-3	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	.5-2
	3-9	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	9-54	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	54-60	8-27	1.65-1.80	0.6-2.0	0.09-0.14	5.1-7.8	Low-----	0.28			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
679C----- Menahga	0-3	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	.5-2
	3-27	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	27-35	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	35-60	8-27	1.65-1.80	0.6-2.0	0.09-0.14	5.1-7.8	Low-----	0.28			
684----- Bergkeller	0-5	6-9	1.30-1.50	2.0-6.0	0.16-0.18	4.5-6.0	Low-----	0.20	4	3	.5-2
	5-20	6-9	1.30-1.50	0.6-6.0	0.09-0.13	4.5-6.0	Low-----	0.17			
	20-33	10-18	1.40-1.70	0.6-2.0	0.10-0.16	5.1-6.0	Low-----	0.20			
	33-60	1-4	1.35-1.60	>6.0	0.05-0.07	5.6-7.3	Low-----	0.10			
701----- Runeberg	0-3	10-25	1.40-1.55	0.6-2.0	0.18-0.25	6.1-7.3	Low-----	0.24	5	5	4-12
	3-26	10-18	1.60-1.75	0.2-0.6	0.12-0.18	6.1-7.3	Low-----	0.24			
	26-60	6-15	1.65-1.75	0.06-0.6	0.06-0.13	7.4-8.4	Low-----	0.24			
703----- Paddock	0-7	10-20	1.40-1.60	0.6-2.0	0.20-0.22	5.6-7.3	Low-----	0.32	4	5	3-7
	7-20	3-10	1.50-1.75	0.6-2.0	0.12-0.16	5.6-6.5	Low-----	0.24			
	20-45	8-18	1.60-1.80	0.2-0.6	0.12-0.16	6.6-7.3	Low-----	0.24			
	45-60	6-15	1.80-2.00	<0.06	0.0-0.04	6.6-8.4	Low-----	0.24			
720B----- Blowers	0-9	5-15	1.55-1.80	0.6-2.0	0.13-0.18	5.1-7.3	Low-----	0.24	4	3	2-6
	9-25	5-10	1.60-1.80	0.6-2.0	0.12-0.15	5.1-6.5	Low-----	0.28			
	25-32	8-18	1.60-1.75	0.6-2.0	0.12-0.15	5.6-7.3	Low-----	0.24			
	32-49	8-18	1.65-1.80	0.2-0.6	0.12-0.15	5.6-7.3	Low-----	0.24			
	49-60	7-15	1.80-2.00	<0.06	0.0-0.04	6.6-8.4	Low-----	0.24			
730A----- Sanburn	0-3	4-12	1.35-1.60	2.0-6.0	0.12-0.15	5.1-6.5	Low-----	0.20	4	3	1-3
	3-16	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	16-24	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	24-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
730B----- Sanburn	0-5	4-12	1.35-1.60	2.0-6.0	0.12-0.15	5.1-6.5	Low-----	0.20	4	3	1-3
	5-16	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	16-21	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	21-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
730C----- Sanburn	0-7	4-12	1.35-1.60	2.0-6.0	0.12-0.15	5.1-6.5	Low-----	0.20	4	3	1-3
	7-16	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	16-23	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	23-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
731A----- Sanburn	0-6	2-4	1.45-1.60	2.0-6.0	0.09-0.11	5.1-6.5	Low-----	0.17	4	2	.5-2
	6-15	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	15-26	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	26-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
731B----- Sanburn	0-8	2-4	1.45-1.60	2.0-6.0	0.09-0.11	5.1-6.5	Low-----	0.17	4	2	.5-2
	8-19	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	19-30	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	30-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
731C----- Sanburn	0-8	2-4	1.45-1.60	2.0-6.0	0.09-0.11	5.1-6.5	Low-----	0.17	4	2	.5-2
	8-14	4-12	1.45-1.60	2.0-6.0	0.07-0.09	5.1-6.5	Low-----	0.20			
	14-22	6-15	1.45-1.65	2.0-6.0	0.07-0.12	5.1-6.5	Low-----	0.17			
	22-60	1-4	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low-----	0.10			
732----- Bushville	0-5	2-10	1.40-1.50	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	4	2	.5-1
	5-27	2-8	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	27-38	10-18	1.55-1.65	0.6-2.0	0.10-0.15	5.1-6.5	Low-----	0.24			
	38-48	5-16	1.65-1.75	0.06-0.2	0.03-0.08	5.1-7.3	Low-----	0.24			
	48-60	5-16	1.80-2.00	0.00-0.06	0.0-0.04	5.6-7.3	Low-----	0.24			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
739B----- Wabedo	0-4	8-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.0	Low-----	0.28	4	3	.5-4
	4-25	5-18	1.45-1.80	0.6-2.0	0.12-0.16	4.5-6.5	Low-----	0.28			
	25-41	4-18	1.75-1.90	0.06-0.2	0.03-0.08	5.1-7.3	Low-----	0.28			
	41-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.1-7.3	Low-----	0.28			
742B----- Flak	0-4	5-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.5	Low-----	0.28	4	3	.5-2
	4-13	5-18	1.45-1.70	2.0-6.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	13-22	8-18	1.45-1.80	0.6-2.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	22-41	4-18	1.75-1.90	<0.2	0.0-0.06	5.1-7.3	Low-----	0.28			
	41-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
742C----- Flak	0-4	5-18	1.40-1.60	2.0-6.0	0.13-0.18	4.5-6.5	Low-----	0.28	4	3	.5-2
	4-15	5-18	1.45-1.70	2.0-6.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	15-24	8-18	1.45-1.80	0.6-2.0	0.12-0.16	5.1-6.5	Low-----	0.28			
	24-30	4-18	1.75-1.90	<0.2	0.0-0.06	5.1-7.3	Low-----	0.28			
	30-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
750B----- Pomroy	0-4	5-12	1.40-1.50	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	4	2	.5-1
	4-14	2-10	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	14-24	6-18	1.65-1.90	0.2-0.6	0.0-0.08	5.1-6.5	Low-----	0.24			
	24-42	5-15	1.75-1.90	<0.2	0.0-0.08	5.6-7.3	Low-----	0.24			
	42-60	5-15	1.80-2.00	<0.6	0.0-0.04	5.6-7.3	Low-----	0.24			
750C----- Pomroy	0-3	5-12	1.40-1.50	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	4	2	.5-1
	3-7	2-10	1.50-1.70	6.0-20	0.06-0.09	5.1-6.5	Low-----	0.15			
	7-34	6-18	1.65-1.90	0.2-0.6	0.0-0.08	5.1-6.5	Low-----	0.24			
	34-40	5-15	1.75-1.90	<0.2	0.0-0.08	5.6-7.3	Low-----	0.24			
	40-60	5-15	1.80-2.00	<0.6	0.0-0.04	5.6-7.3	Low-----	0.24			
773B: Warba-----	0-17	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----	0.20	5	3	1-3
	17-36	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate----	0.32			
	36-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate----	0.32			
Cromwell-----	0-16	5-18	1.20-1.40	0.6-2.0	0.16-0.18	4.5-6.0	Low-----	0.20	3	3	.5-2
	16-60	0-8	1.35-1.60	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.05			
773E: Warba-----	0-11	5-15	1.10-1.40	2.0-6.0	0.18-0.23	5.1-6.5	Low-----	0.20	5	3	1-3
	11-45	23-35	1.50-1.70	0.2-0.6	0.16-0.19	5.1-7.3	Moderate----	0.32			
	45-60	20-32	1.50-1.70	0.2-2.0	0.16-0.19	6.6-8.4	Moderate----	0.32			
Cromwell-----	0-23	5-18	1.20-1.40	0.6-2.0	0.16-0.18	4.5-6.0	Low-----	0.20	3	3	.5-2
	23-60	0-8	1.35-1.60	6.0-20	0.05-0.07	5.1-7.3	Low-----	0.05			
788: Cathro-----	0-32	---	0.28-0.45	0.2-6.0	0.45-0.55	4.5-7.8	-----	---	5	2	60-85
	32-60	10-30	1.50-1.70	0.2-2.0	0.11-0.22	6.6-8.4	Low-----	0.20			
Seelyeville-----	0-12	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	---	5	2	25-99
	12-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	---			
797: Mooselake-----	0-8	---	0.05-0.30	0.6-6.0	0.35-0.55	4.5-7.3	-----	---	3	5	25-99
	8-60	---	0.10-0.20	0.6-6.0	0.40-0.50	4.5-7.3	-----	---			
Lupton-----	0-25	---	0.10-0.35	0.2-6.0	0.35-0.45	4.5-7.8	-----	---	5	2	70-90
	25-60	---	0.10-0.35	0.2-6.0	0.35-0.45	4.5-7.8	-----	---			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
799:											
Bowstring-----	0-32	---	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-----	----	3	8	40-90
	32-40	1-12	1.40-1.60	0.6-2.0	0.08-0.14	5.6-8.4	Low-----	----			
	40-60	---	0.15-0.30	0.2-6.0	0.35-0.45	5.6-8.4	-----	----			
Seelyeville-----	0-10	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	----	3	2	>25
	10-60	---	0.10-0.25	0.2-6.0	0.35-0.45	4.5-7.3	-----	----			
870B:											
Itasca-----	0-12	3-10	1.35-1.55	0.6-2.0	0.22-0.24	5.1-6.5	Low-----	0.37	5	5	.5-3
	12-20	3-10	1.60-1.75	0.6-2.0	0.17-0.22	5.1-6.0	Low-----	0.37			
	20-43	8-18	1.60-1.80	0.6-2.0	0.11-0.19	5.6-7.3	Low-----	0.24			
	43-60	8-18	1.60-1.80	0.6-2.0	0.11-0.19	6.6-8.4	Low-----	0.24			
Goodland-----	0-13	4-10	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low-----	0.37	5	5	.5-2
	13-27	8-18	1.60-1.75	0.6-2.0	0.12-0.19	5.1-6.5	Low-----	0.28			
	27-35	2-10	1.65-1.85	2.0-6.0	0.06-0.10	5.1-6.5	Low-----	0.10			
	35-60	0-5	1.65-1.85	6.0-20	0.02-0.07	5.6-7.8	Low-----	0.10			
870C:											
Itasca-----	0-6	3-10	1.35-1.55	0.6-2.0	0.22-0.24	5.1-6.5	Low-----	0.37	5	5	.5-3
	6-20	3-10	1.60-1.75	0.6-2.0	0.17-0.22	5.1-6.0	Low-----	0.37			
	20-48	8-18	1.60-1.80	0.6-2.0	0.11-0.19	5.6-7.3	Low-----	0.24			
	48-60	8-15	1.60-1.80	0.6-2.0	0.11-0.19	6.6-8.4	Low-----	0.24			
Goodland-----	0-6	4-10	1.35-1.55	0.6-2.0	0.20-0.24	5.1-6.5	Low-----	0.37	5	5	.5-2
	6-40	8-18	1.60-1.75	0.6-2.0	0.12-0.19	5.1-6.5	Low-----	0.28			
	40-46	2-10	1.65-1.85	2.0-6.0	0.06-0.10	5.1-6.5	Low-----	0.10			
	46-60	0-5	1.65-1.85	6.0-20	0.02-0.07	5.6-7.8	Low-----	0.10			
928B:											
Demontreville---	0-2	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	2-22	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	22-39	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	39-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
Mahtomedi-----	0-2	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	2-9	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	9-16	0-10	1.45-1.75	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.05			
	16-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
Cushing-----	0-3	6-14	1.35-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.24	5	3	1-2
	3-19	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	19-32	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	32-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			
928C:											
Demontreville---	0-1	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	1-31	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	31-46	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	46-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
Mahtomedi-----	0-2	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	2-4	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	4-19	0-10	1.45-1.75	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.05			
	19-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
Cushing-----	0-3	6-14	1.35-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.24	5	3	1-2
	3-21	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	21-40	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	40-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
928E:											
Demontreville---	0-4	2-6	1.50-1.68	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	5	2	.5-1
	4-33	1-6	1.55-1.75	6.0-20	0.06-0.09	5.1-7.3	Low-----	0.17			
	33-42	6-20	1.65-1.75	0.2-0.6	0.08-0.14	5.6-6.5	Low-----	0.28			
	42-60	5-10	1.65-1.75	0.2-0.6	0.06-0.10	5.6-7.3	Low-----	0.28			
Mahtomedi-----	0-3	2-15	1.40-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.15	5	2	.5-1
	3-23	0-10	1.40-1.50	6.0-20	0.06-0.08	5.1-6.5	Low-----	0.10			
	23-60	0-10	1.45-1.75	6.0-20	0.04-0.09	5.1-7.8	Low-----	0.05			
Cushing-----	0-7	6-14	1.35-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.24	5	3	1-2
	7-16	4-16	1.55-1.65	0.6-2.0	0.10-0.22	5.1-7.8	Low-----	0.32			
	16-49	18-35	1.55-1.70	0.6-2.0	0.10-0.19	5.1-7.8	Low-----	0.32			
	49-60	8-21	1.45-1.80	0.2-0.6	0.09-0.19	5.1-8.4	Low-----	0.32			
1002-----	0-12	6-18	1.20-1.40	0.6-2.0	0.18-0.24	6.6-7.8	Low-----	0.28	5	5	3-10
Fluvaquents	12-60	10-27	1.30-1.60	0.6-2.0	0.12-0.22	6.6-7.8	Moderate----	0.24			
1141-----	0-10	10-25	1.40-1.55	0.6-2.0	0.18-0.22	6.1-7.3	Low-----	0.28	5	5	4-12
Runeberg	10-27	10-18	1.60-1.75	0.2-0.6	0.12-0.18	6.1-7.3	Low-----	0.28			
	27-60	6-15	1.65-1.75	0.06-0.6	0.06-0.13	6.1-7.3	Low-----	0.28			
1151B-----	0-5	5-15	1.55-1.80	0.6-2.0	0.13-0.18	5.1-6.5	Low-----	0.24	4	3	2-6
Blowers	5-17	5-10	1.60-1.80	0.6-2.0	0.12-0.15	5.1-6.5	Low-----	0.28			
	17-23	8-18	1.60-1.75	0.6-2.0	0.12-0.15	5.1-6.5	Low-----	0.24			
	23-44	8-18	1.65-1.80	0.2-0.6	0.12-0.15	5.1-6.5	Low-----	0.24			
	44-60	4-15	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.24			
1153B-----	0-14	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	4	2	1-3
Huntersville	14-26	2-6	1.45-1.65	6.0-20	0.04-0.10	5.1-6.5	Low-----	0.15			
	26-58	6-18	1.65-1.80	0.2-0.6	0.11-0.13	5.1-6.5	Low-----	0.20			
	58-60	6-15	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.20			
1155-----	0-4	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17	4	2	2-8
Staples	4-27	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	27-35	8-18	1.65-1.80	0.2-0.6	0.06-0.13	5.1-6.5	Low-----	0.28			
	35-60	6-15	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.28			
1157-----	0-7	10-20	1.40-1.60	0.6-2.0	0.20-0.22	5.1-7.3	Low-----	0.32	4	5	3-7
Paddock	7-20	3-10	1.50-1.75	0.6-2.0	0.12-0.16	5.1-6.5	Low-----	0.24			
	20-41	8-18	1.60-1.80	0.2-0.6	0.12-0.16	5.1-6.5	Low-----	0.24			
	41-60	6-15	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.24			
1160B-----	0-6	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	1-3
Redeye	6-15	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	15-33	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	33-55	6-18	1.65-1.80	0.2-0.6	0.11-0.13	5.1-6.5	Low-----	0.28			
	55-60	5-14	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.28			
1160C-----	0-7	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	1-3
Redeye	7-14	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	14-27	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	27-44	6-18	1.65-1.80	0.2-0.6	0.11-0.13	5.1-6.5	Low-----	0.28			
	44-60	5-14	1.80-2.00	<0.06	0.0-0.04	5.1-6.5	Low-----	0.28			
1943-----	0-6	0-12	0.90-1.60	6.0-20	0.08-0.20	5.6-7.8	Low-----	0.17	5	2	4-15
Roscommon	6-60	0-10	1.45-1.70	6.0-20	0.05-0.09	5.6-8.4	Low-----	0.17			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1956----- Staples	0-7	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	2-8
	7-36	2-6	1.45-1.60	6.0-20	0.07-0.10	5.1-7.3	Low-----	0.15			
	36-44	8-35	1.65-1.80	0.2-0.6	0.06-0.13	5.1-7.3	Low-----	0.28			
	44-60	6-15	1.80-2.00	0.00-0.2	0.0-0.04	6.6-7.8	Low-----	0.28			
1957B----- Friendship	0-8	3-10	1.50-1.65	6.0-20	0.08-0.12	5.1-7.3	Low-----	0.17	5	2	.5-2
	8-48	2-7	1.50-1.65	6.0-20	0.05-0.11	5.1-6.5	Low-----	0.17			
	48-60	10-20	1.60-1.80	0.2-2.0	0.07-0.13	4.5-7.3	Low-----	0.24			
1970B----- Manahga	0-4	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	.5-2
	4-9	2-6	1.45-1.65	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17			
	9-49	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	49-60	5-14	1.80-2.00	<0.06	0.0-0.04	5.1-7.8	Low-----	0.28			
1970C----- Manahga	0-3	2-6	1.45-1.60	6.0-20	0.10-0.12	5.1-7.3	Low-----	0.17	4	2	.5-2
	3-7	2-6	1.45-1.65	6.0-20	0.10-0.12	5.1-6.5	Low-----	0.17			
	7-48	2-6	1.45-1.65	6.0-20	0.07-0.10	5.1-6.5	Low-----	0.15			
	48-60	5-14	1.80-2.00	<0.06	0.0-0.04	5.1-7.8	Low-----	0.28			
1978----- Nokay	0-5	6-18	1.30-1.50	0.6-2.0	0.18-0.22	4.5-5.5	Low-----	0.32	4	5	3-8
	5-17	5-15	1.45-1.70	0.6-6.0	0.12-0.19	4.5-5.5	Low-----	0.28			
	17-33	8-18	1.45-1.75	0.6-2.0	0.12-0.19	5.1-6.5	Low-----	0.28			
	33-41	4-18	1.75-1.90	<0.2	0.0-0.08	5.6-7.3	Low-----	0.28			
	41-60	4-18	1.80-2.00	<0.06	0.0-0.04	5.6-7.3	Low-----	0.28			
1995B----- Bergkeller	0-3	6-9	1.30-1.50	2.0-6.0	0.16-0.18	4.5-6.0	Low-----	0.20	4	3	.5-2
	3-21	6-9	1.30-1.50	0.6-6.0	0.09-0.13	4.5-6.0	Low-----	0.17			
	21-32	10-18	1.40-1.70	0.6-2.0	0.10-0.16	5.1-6.0	Low-----	0.20			
	32-60	1-4	1.35-1.60	6.0-20	0.05-0.07	5.6-7.3	Low-----	0.10			
1996----- Cromwell	0-17	5-18	1.20-1.40	0.6-2.0	0.16-0.18	4.5-6.0	Low-----	0.24	3	3	.5-2
	17-60	0-8	1.40-1.70	6.0-20	0.05-0.07	5.1-6.5	Low-----	0.15			

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "frequent," "long," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
7A, 7B----- Hubbard	A	None-----	---	---	>6.0	---	---	In	Low-----	Low-----	Low.
4B----- Hiwood	A	None-----	---	---	2.0-5.0	Apparent	Apr-Jul	---	Moderate	Low-----	Low.
82B, 82C----- Redeye	B	None-----	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
119B, 119C----- Pomroy	C	None-----	---	---	>6.0	---	---	---	Low-----	Moderate	Low.
126B, 126C----- Graycalm	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.
139B----- Huntersville	B	None-----	---	---	2.0-3.5	Perched	Nov-Jul	---	High-----	Moderate	Moderate.
142----- Nokay	C	None-----	---	---	1.0-2.5	Perched	Apr-Jun	---	High-----	Moderate	High.
144B, 144C----- Flak	C	None-----	---	---	>6.0	---	---	---	Moderate	Low-----	Moderate.
146B----- Wabedo	C	None-----	---	---	2.0-3.5	Perched	Apr-Jun	---	Moderate	Moderate	Moderate.
147----- Spoonier	C/D	None-----	---	---	0.5-1.5	Apparent	Nov-Jul	---	High-----	High-----	Low.
158B----- Zimmerman	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	High.
167B----- Baudette	B	None-----	---	---	2.5-4.0	Apparent	Apr-Jun	---	High-----	Moderate	Low.
202----- Meehan	B	None-----	---	---	1.0-3.0	Apparent	Oct-Jun	---	Moderate	Low-----	Moderate.
204B, 204C, 204E----- Cushing	B	None-----	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>			
217----- Nokasippi	B/D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	---	High-----	High-----	Moderate.
218----- Watab	C	None-----	---	---	0-1.0	Perched	Mar-Jun	---	Moderate	Moderate	Moderate.
240A----- Warba	B	None-----	---	---	3.5-6.0	Apparent	Apr-May	---	Moderate	Moderate	Moderate.
240B, 240C----- Warba	B	None-----	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.
243----- Stuntz	C	None-----	---	---	1.5-3.0	Apparent	Mar-Jun	---	High-----	High-----	Moderate.
268B, 268C----- Crownwell	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.
292----- Aistad	C	None-----	---	---	1.0-3.0	Perched	Nov-May	---	High-----	Moderate	Moderate.
453B, 453C, 453E----- Dumontreville	B	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.
454B, 454C, 454E----- Mahtomedi	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	High.
458A, 458B, 458C, 458E----- Menahga	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.
540----- Seelyeville	A/D	None-----	---	---	+1-0.5	Apparent	Oct-Jun	50-55	High-----	High-----	Moderate.
541----- Rifle	A/D	None-----	---	---	+1-1.0	Apparent	Nov-Jun	---	High-----	High-----	Low.
543----- Markey	A/D	None-----	---	---	+1-1.0	Apparent	Nov-Jun	25-30	High-----	High-----	Low.
544----- Cathro	A/D	None-----	---	---	+1-1.0	Apparent	Oct-Jun	19-22	High-----	High-----	Low.
549----- Greenwood	A/D	None-----	---	---	0-1.0	Apparent	Sep-Jun	55-60	High-----	High-----	High.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding				High water table				Total subsidence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Uncoated steel	Concrete				
564----- Friendship	A	None-----	---	---	<u>Ft</u> 3.5-6.0	Apparent	Oct-Jun	---	Low-----	Low-----	High.		
620B, 620D----- Cutaway	B	None-----	---	---	>6.0	---	---	---	Low-----	Moderate	Moderate.		
625----- Sandwick	B	None-----	---	---	0.5-1.5	Apparent	Apr-Jun	---	Moderate	High-----	Moderate.		
665B, 665C, 665E, 679B, 679C----- Menahga	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.		
684----- Bergkeller	B	None-----	---	---	2.5-6.0	Apparent	Oct-May	---	Low-----	Moderate	Moderate.		
701----- Runeberg	C/D	None-----	---	---	+1-1.0	Apparent	Jan-Dec	---	High-----	High-----	Low.		
703----- Paddock	C/D	None-----	---	---	1.0-3.0	Perched	Nov-Jun	---	High-----	High-----	Moderate.		
720B----- Blowers	B	None-----	---	---	2.0-3.0	Perched	Oct-Jun	---	High-----	Moderate	Moderate.		
730A, 730B, 730C, 731A, 731B, 731C----- Sanburn	B	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.		
732----- Bushville	C	None-----	---	---	1.5-2.5	Perched	Mar-Jun	---	Low-----	Moderate	Moderate.		
739B----- Wabedo	C	None-----	---	---	2.0-3.5	Perched	Apr-Jun	---	Moderate	Moderate	Moderate.		
742B, 742C----- Flak	C	None-----	---	---	>6.0	---	---	---	Moderate	Low-----	Moderate.		
750B, 750C----- Pomroy	C	None-----	---	---	>6.0	---	---	---	Low-----	Moderate	Low.		
773B, 773E: Warba-----	B	None-----	---	---	>6.0	---	---	---	Moderate	Moderate	Moderate.		
Cromwell-----	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.		

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Total subsi- dence	Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months			Uncoated steel	Concrete
1943----- Rowcommon	A/D	None-----	---	---	+1-1.0	Apparent	Sep-Jun	---	Moderate	High-----	Low.
1956----- Staples	B/D	None-----	---	---	0-1.0	Perched	Nov-Jul	---	High-----	High-----	Moderate.
19578----- Friendship	A	None-----	---	---	3.0-6.0	Perched	Nov-May	---	Low-----	Low-----	High.
1970B, 1970C----- Manahga	A	None-----	---	---	>6.0	---	---	---	Low-----	Low-----	Moderate.
1978----- Nokay	C	None-----	---	---	1.0-2.5	Perched	Apr-Jun	---	High-----	Moderate	High.
1995B----- Bergkeller	B	None-----	---	---	>6.0	---	---	---	Low-----	Moderate	Moderate.
1996----- Cromwell	A	None-----	---	---	2.5-5.0	Apparent	Mar-Jun	---	Low-----	Low-----	Moderate.

TABLE 18.--CLASSIFICATION OF THE SOILS

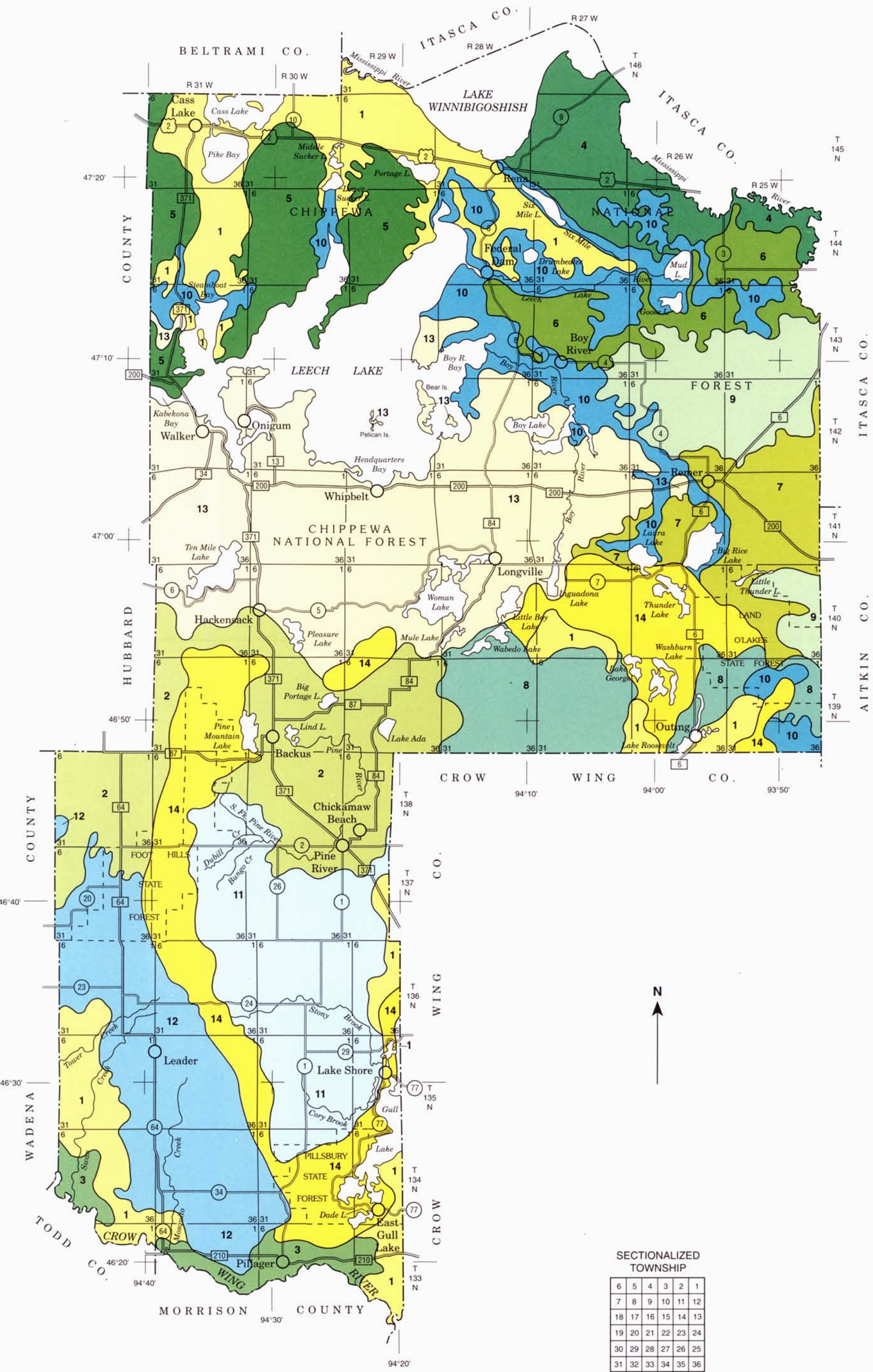
Soil name	Family or higher taxonomic class
Alstad-----	Fine-loamy, mixed Glossaquic Eutroboralfs
Baudette-----	Fine-silty, mixed Aquic Eutroboralfs
Bergkeller-----	Coarse-loamy, mixed Typic Eutroboralfs
Blowers-----	Coarse-loamy, mixed Glossaquic Eutroboralfs
Bowstring-----	Euic Fluvaquentic Borosaprista
Bushville-----	Loamy, mixed Aquic Arenic Eutroboralfs
Cathro-----	Loamy, mixed, euic Terric Borosaprista
Cromwell-----	Sandy, mixed, frigid Typic Dystrichrepts
Cushing-----	Fine-loamy, mixed Glossic Eutroboralfs
Cutaway-----	Loamy, mixed Arenic Eutroboralfs
Demontreville-----	Loamy, mixed Arenic Eutroboralfs
Flak-----	Coarse-loamy, mixed Typic Eutroboralfs
Fluvaquents-----	Loamy Fluvaquents
Friendship-----	Mixed, frigid Typic Udipsamments
Goodland-----	Coarse-loamy, mixed Glossic Eutroboralfs
Graycalm-----	Mixed, frigid Argic Udipsamments
Greenwood-----	Dysic Typic Borohemists
Hiwood-----	Mixed, frigid Aquic Udipsamments
Hubbard-----	Sandy, mixed Udorthentic Haploborolls
Huntersville-----	Loamy, mixed Aquic Arenic Eutroboralfs
Itasca-----	Coarse-loamy, mixed Glossic Eutroboralfs
Lupton-----	Euic Typic Borosaprista
Mahtomedi-----	Mixed, frigid Typic Udipsamments
Markey-----	Sandy or sandy-skeletal, mixed, euic Terric Borosaprista
Meehan-----	Mixed, frigid Aquic Udipsamments
Menahga-----	Mixed, frigid Typic Udipsamments
Mooselake-----	Euic Typic Borohemists
Nokasippi-----	Coarse-loamy, mixed, frigid Typic Epiaquolls
Nokay-----	Coarse-loamy, mixed, frigid Udollic Epiaqualfs
Paddock-----	Coarse-loamy, mixed, frigid Udollic Epiaqualfs
Pomroy-----	Loamy, mixed Arenic Eutroboralfs
Redby-----	Mixed, frigid Aquic Udipsamments
Redeye-----	Loamy, mixed Arenic Eutroboralfs
Rifle-----	Euic Typic Borohemists
Roscommon-----	Mixed, frigid Mollic Psammaquents
Runeberg-----	Coarse-loamy, mixed, frigid Typic Endoaquolls
Sanburn-----	Coarse-loamy, mixed Typic Eutroboralfs
Sandwich-----	Loamy, mixed, frigid Arenic Glossaqualfs
Seelyeville-----	Euic Typic Borosaprista
Spooner-----	Fine-silty, mixed, frigid Mollic Endoaqualfs
Staples-----	Loamy, mixed, frigid Arenic Epiaqualfs
Stuntz-----	Fine-loamy, mixed, frigid Aeris Glossaqualfs
Suomi-----	Fine, mixed Glossic Eutroboralfs
Wabedo-----	Coarse-loamy, mixed, frigid Aquic Dystric Eutrochrepts
Warba-----	Fine-loamy, mixed Glossic Eutroboralfs
Watab-----	Loamy, mixed, frigid Arenic Epiaqualfs
Zimmerman-----	Mixed, frigid Argic Udipsamments

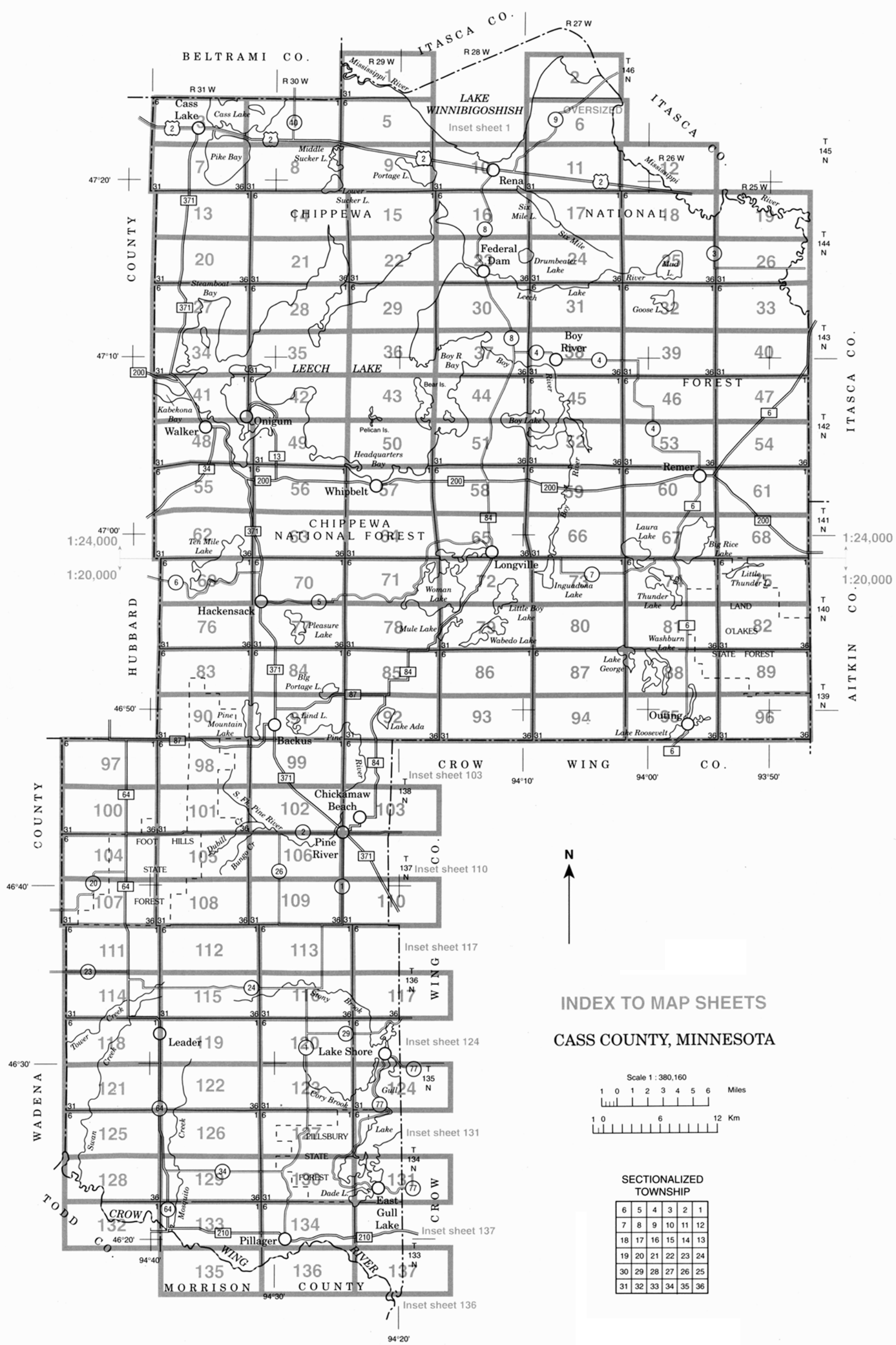
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Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.





SOIL LEGEND

Soils outside the administrative boundary of the Chippewa National Forest. Map symbols consist of a number or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

Soils within the administrative boundary of the Chippewa National Forest. Map symbols consist of a combination of letters and numbers. The first letter of the map unit generally refers to the Land Type Association (LTA) where the unit occurs. Histosols are designated with an 'X' as the first letter of the map unit symbol because they occur in all LTAs.

SYMBOL	NAME	SYMBOL	NAME
7A	Hubbard loamy sand, 0 to 3 percent slopes	A10	Glossaqualfs
7B	Hubbard loamy sand, 3 to 8 percent slopes	A12	Warba-Aquic Eutroboralfs, loamy-Aeric Glossaqualfs, loamy, association, nearly level to gently rolling
48	Hiwood loamy fine sand	A13	Warba-Aquic Eutroboralfs, loamy-Aeric Glossaqualfs, loamy, association, nearly level to hilly
82B	Redeye loamy sand, 1 to 6 percent slopes	A15	Typic Udipsamments-Arenic Eutroboralfs-Alfic Udipsamments association, nearly level to gently rolling
82C	Redeye loamy sand, 6 to 12 percent slopes	A16	Warba-Dystic Eutrochrepts-Typic Udipsamments association, nearly level to gently rolling
119B	Pomroy loamy sand, 3 to 8 percent slopes	A17	Menahga-Cutaway-Glossic Eutroboralfs association, rolling and hilly
119C	Pomroy loamy sand, 8 to 15 percent slopes	A18	Arenic Eutroboralfs, nearly level to gently rolling
126B	Graycalm loamy sand, 1 to 8 percent slopes	A19	Menahga loamy coarse sand, moraine, rolling and hilly
126C	Graycalm loamy sand, 8 to 15 percent slopes	A20	Typic Udipsamments, gravelly, rolling to very hilly
139B	Huntersville loamy fine sand, 1 to 6 percent slopes	E57	Zimmerman loamy fine sand, nearly level and undulating
142	Nokay loam	E58	Graycalm-Typic Udipsamments association, nearly level and undulating
144B	Flak sandy loam, 3 to 8 percent slopes	E59	Warba-Stuntz-Arenic Eutroboralfs association, nearly level and undulating
144C	Flak sandy loam, 8 to 15 percent slopes	E60	Warba-Stuntz association, nearly level and undulating
146B	Wabedo sandy loam, 1 to 6 percent slopes	E61	Glossic Eutroboralfs, loamy, rolling and hilly
147	Spooner very fine sandy loam	E62	Warba-Histosols association, nearly level to gently rolling
158B	Zimmerman fine sand, 1 to 8 percent slopes	E63	Aquic Eutroboralfs, clayey subsoil, nearly level and undulating
167B	Baudette silt loam, 1 to 6 percent slopes	E65	Aeric Glossaqualfs, loamy
202	Meehan loamy sand	F76	Warba very fine sandy loam, nearly level and undulating
204B	Cushing loam, 2 to 8 percent slopes	F77	Warba very fine sandy loam, rolling and hilly
204C	Cushing loam, 8 to 15 percent slopes	K22	Alfic Udipsamments, nearly level and undulating
204E	Cushing loam, 15 to 30 percent slopes	K25	Eutroboralfs-Typic Ochraqualfs association, nearly level and undulating
217	Nokasippi loamy fine sand	K27	Aquic Eutroboralfs, loamy, nearly level and undulating
218	Watab loamy sand	K28	Aquic Eutroboralfs, silty, nearly level and undulating
240A	Warba very fine sandy loam, 1 to 3 percent slopes, moderately wet	K30	Typic Ochraqualfs, clayey
240B	Warba very fine sandy loam, 3 to 8 percent slopes	K31	Suomi-Aeric Glossaqualfs, loamy, association, nearly level and undulating
240C	Warba very fine sandy loam, 8 to 15 percent slopes	K35	Typic Ochraqualfs, ponded
243	Stuntz very fine sandy loam	N77	Udipsamments, nearly level and undulating
268B	Cromwell sandy loam, 1 to 8 percent slopes	N78	Psammentic Eutroboralfs, sandy, nearly level and undulating
268C	Cromwell sandy loam, 8 to 15 percent slopes	N79	Psammentic Eutroboralfs, sandy, rolling and hilly
292	Alstad fine sandy loam	N80	Cutaway-Hiwood association, nearly level and undulating
453B	Demontreville loamy sand, 2 to 8 percent slopes	O92	Hiwood-Zimmerman association, nearly level to hilly
453C	Demontreville loamy sand, 8 to 15 percent slopes	O93	Eutroboralfs, nearly level and undulating
453E	Demontreville loamy sand, 15 to 40 percent slopes	O94	Redby fine sand
454B	Mahtomedi loamy sand, 1 to 8 percent slopes	O95	Humaquepts
454C	Mahtomedi loamy sand, 8 to 15 percent slopes	O96	Mollic Fluvaquents, frequently flooded
454E	Mahtomedi loamy sand, 15 to 40 percent slopes	O97	Humaquepts, sandy
458A	Menahga loamy sand, 0 to 3 percent slopes	X01	Histosols, depressional
458B	Menahga loamy sand, 3 to 8 percent slopes	X02	Typic Borohemists, acid
458C	Menahga loamy sand, 8 to 15 percent slopes	X03	Typic Borohemists, nonacid-Typic Borosapristis association
458E	Menahga loamy sand, 15 to 40 percent slopes	X04	Typic Borosapristis-Bowstring association
540	Seelyville muck	X05	Typic Borohemists, nonacid
541	Rifle mucky peat	XW1	Aqualfs
543	Markey muck		
544	Cathro muck		
549	Greenwood peat		
564	Friendship loamy sand		
620B	Cutaway loamy sand, 1 to 10 percent slopes		
620D	Cutaway loamy sand, 10 to 25 percent slopes		
625	Sandwich loamy sand		
665B	Menahga loamy sand, moraine, 3 to 8 percent slopes		
665C	Menahga loamy sand, moraine, 8 to 15 percent slopes		
665E	Menahga loamy sand, moraine, 15 to 40 percent slopes		
679B	Menahga loamy sand, loamy substratum, 2 to 8 percent slopes		
679C	Menahga loamy sand, loamy substratum, 8 to 15 percent slopes		
684	Bergkeller sandy loam, moderately wet		
701	Runeberg mucky loam, depressional		
703	Paddock loam		
720B	Blowers sandy loam, 1 to 5 percent slopes		
730A	Sanburn sandy loam, 1 to 3 percent slopes		
730B	Sanburn sandy loam, 3 to 8 percent slopes		
730C	Sanburn sandy loam, 8 to 15 percent slopes		
731A	Sanburn loamy sand, 0 to 3 percent slopes		
731B	Sanburn loamy sand, 3 to 8 percent slopes		
731C	Sanburn loamy sand, 8 to 15 percent slopes		
732	Bushville loamy sand, 1 to 3 percent slopes		
739B	Wabedo sandy loam, 1 to 6 percent slopes, very stony		
742B	Flak sandy loam, 3 to 8 percent slopes, very stony		
742C	Flak sandy loam, 8 to 15 percent slopes, very stony		
750B	Pomroy loamy sand, 3 to 8 percent slopes, very stony		
750C	Pomroy loamy sand, 8 to 15 percent slopes, very stony		
773B	Warba-Cromwell complex, 1 to 8 percent slopes		
773E	Warba-Cromwell complex, 8 to 25 percent slopes		
788	Cathro-Seelyville complex		
797	Mooselake and Lupton soils		
799	Bowstring-Seelyville complex, frequently flooded		
870B	Itasca-Goodland complex, 1 to 8 percent slopes		
870C	Itasca-Goodland complex, 8 to 15 percent slopes		
928B	Demontreville-Mahtomedi-Cushing complex, 2 to 8 percent slopes		
928C	Demontreville-Mahtomedi-Cushing complex, 8 to 15 percent slopes		
928E	Demontreville-Mahtomedi-Cushing complex, 15 to 40 percent slopes		
1002	Fluvaquents, frequently flooded		
1141	Runeberg loam, acid substratum, depressional		
1151B	Blowers sandy loam, acid substratum, 1 to 5 percent slopes		
1153B	Huntersville loamy sand, acid substratum, 1 to 6 percent slopes		
1155	Staples loamy sand, acid substratum		
1157	Paddock loam, acid substratum		
1160B	Redeye loamy sand, acid substratum, 1 to 6 percent slopes		
1160C	Redeye loamy sand, acid substratum, 6 to 12 percent slopes		
1943	Roscommon loamy sand		
1956	Staples loamy sand		
1957B	Friendship loamy sand, loamy substratum, 1 to 6 percent slopes		
1970B	Menahga loamy sand, till substratum, 2 to 8 percent slopes		
1970C	Menahga loamy sand, till substratum, 8 to 15 percent slopes		
1978	Nokay loam, very stony		
1995B	Bergkeller sandy loam, 1 to 6 percent slopes		
1996	Cromwell sandy loam, moderately wet		

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

National, state, or province	— — — — —
County or parish	— — — — —
Minor civil division	— — — — —
Reservation (national forest or park, state forest or park, and large airport)	— . — — —
Land grant	— . . — — —
Limit of soil survey (label)	— — — — —
Field sheet matchline and neatline	— — — — —

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool	
--	--

STATE COORDINATE TICK 1 890 000 FEET

LAND DIVISION CORNER (sections and land grants)

ROADS

Divided (median shown if scale permits)	==
Other roads	— — — — —
Trail	- - - - -

ROAD EMBLEM & DESIGNATIONS

Interstate	
Federal	
State	
County, farm or ranch	

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

Without road	
With road	
With railroad	

DAMS

Large (to scale)	
Medium or Small (Named where applicable)	

PITS

Gravel pit	
Mine or quarry	

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban area) (occupied)	
Church	
School	
Indian mound (label)	
Located object (label)	
Tank (label)	
Wells, oil or gas	
Windmill	
Kitchen midden	

WATER FEATURES

DRAINAGE

Perennial, double line	
Perennial, single line	
Intermittent	
Drainage end	
Canals or ditches	
Double-line (label)	
Drainage and/or irrigation	

LAKES, PONDS AND RESERVOIRS

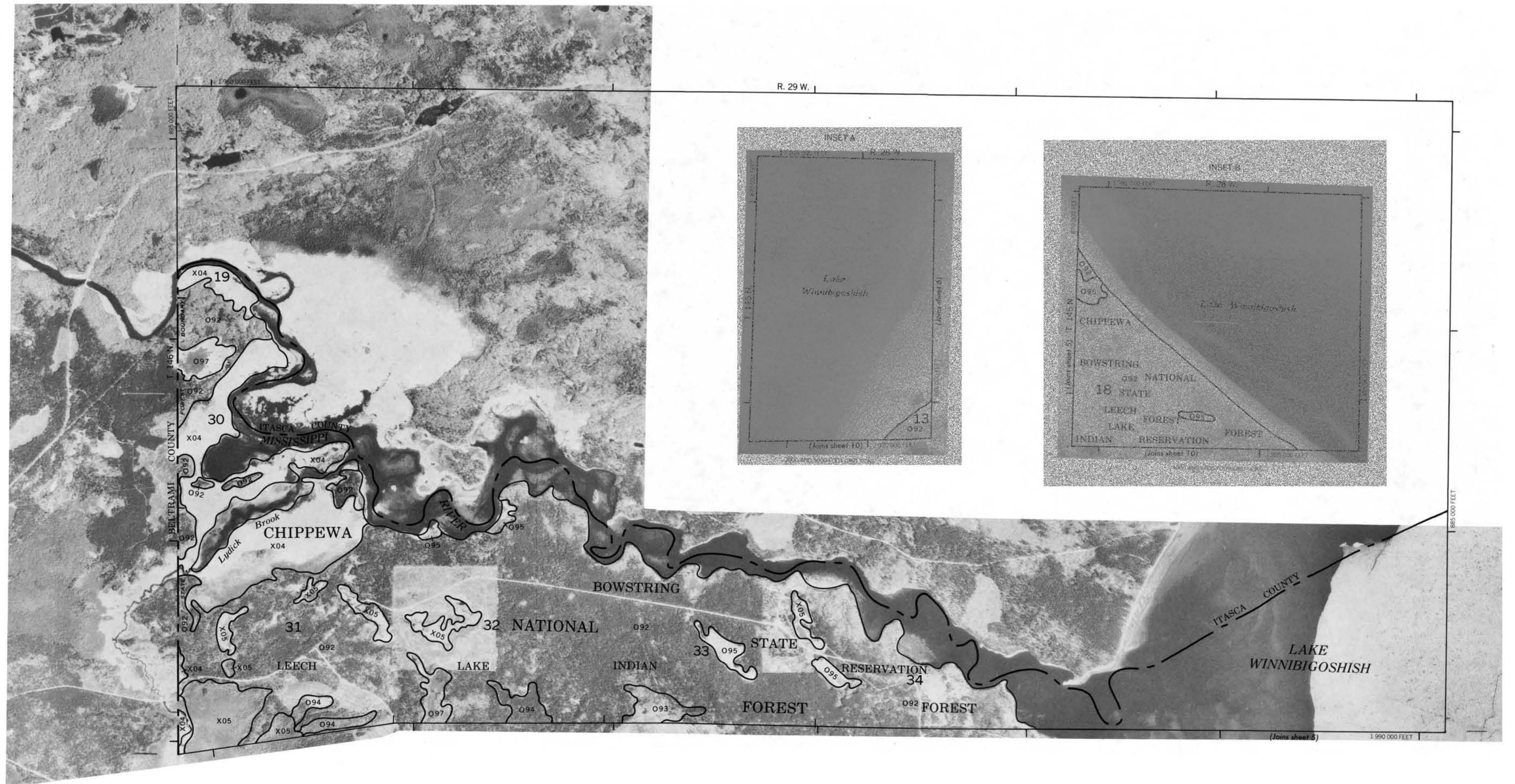
Perennial	
Intermittent	

MISCELLANEOUS WATER FEATURES

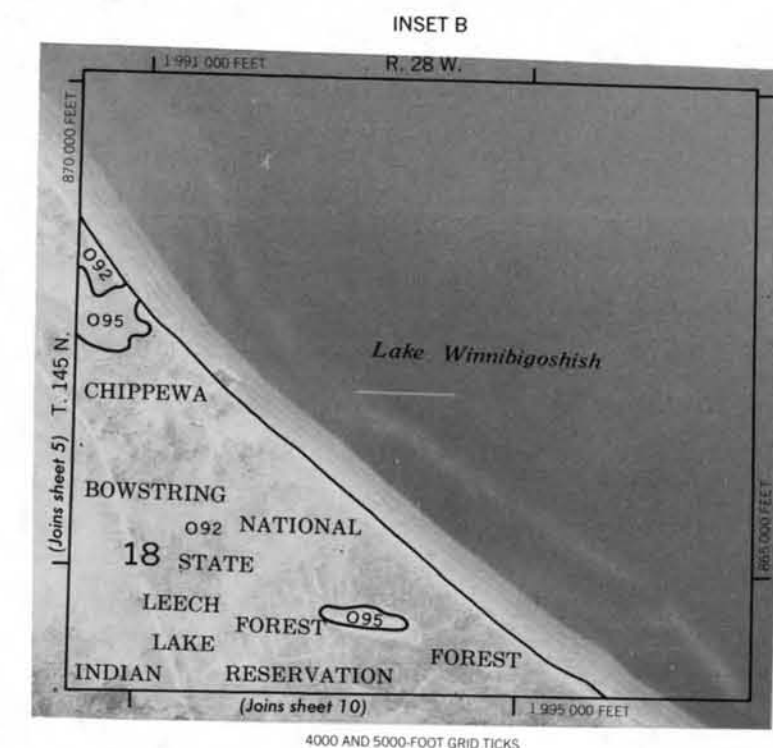
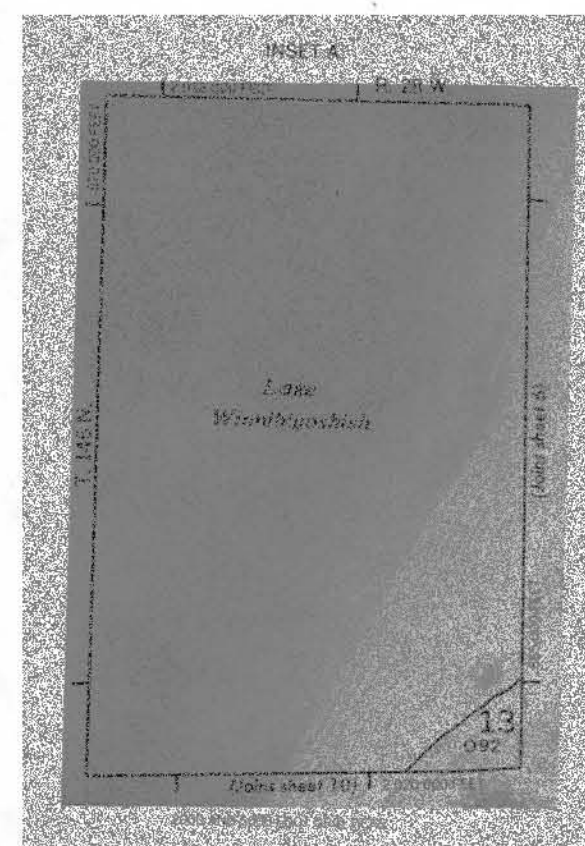
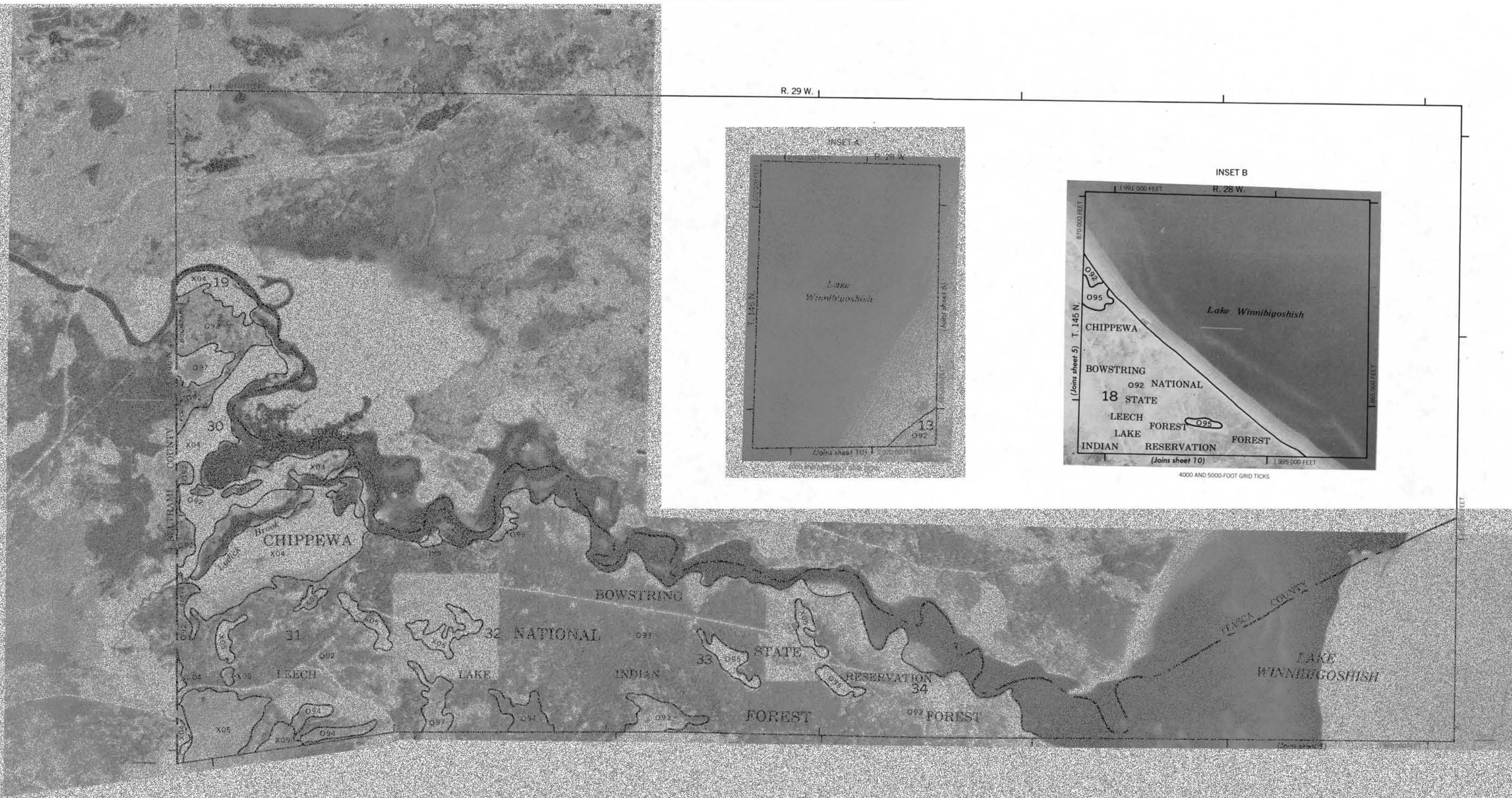
Marsh or swamp	
Spring	
Well, artesian	
Well, irrigation	
Wet spot	

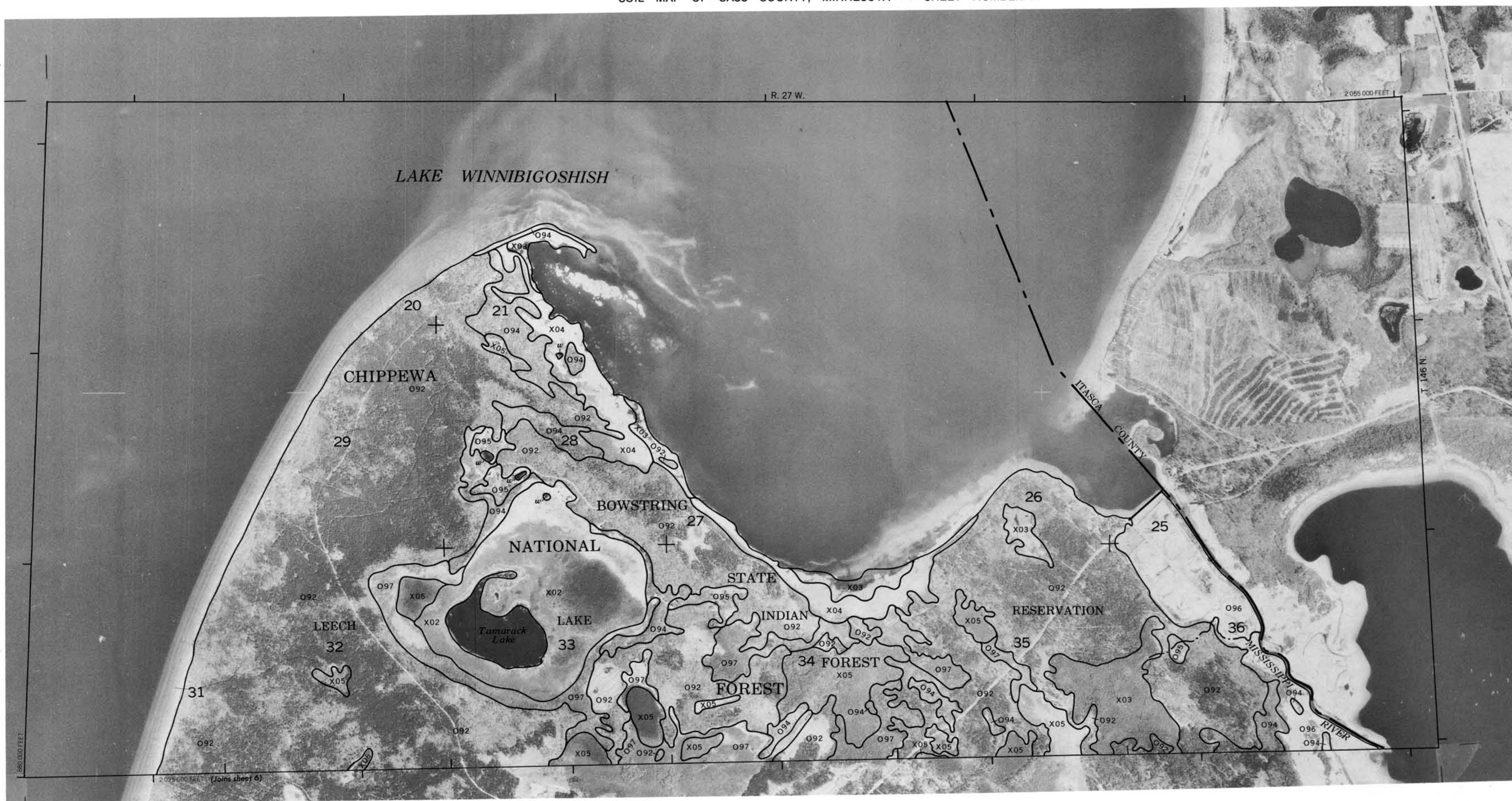
SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS	139B	82C
ESCARPMENTS		
Bedrock (points down slope)	∇ ∇ ∇ ∇ ∇ ∇ ∇	
Other than bedrock (points down slope)	∇ ∇ ∇ ∇ ∇ ∇ ∇	
SHORT STEEP SLOPE	
GULLY	~~~~~	
DEPRESSION OR SINK	◇	
SOIL SAMPLE (normally not shown)	⊙	
MISCELLANEOUS		
Blowout	∪	
Clay spot	⊗	
Gravelly spot	⊙	
Gumbo, slick or scabby spot (sodic)	⊘	
Dumps and other similar non soil areas	≡	
Prominent hill or peak	⊛	
Rock outcrop (includes sandstone and shale)	∇	
Saline spot	+	
Sandy spot	⋈	
Severely eroded spot	≡	
Slide or slip (tips point upslope)))	
Stony spot, very stony spot	0 0	
Better drained soil in poorly drained area	⊕	









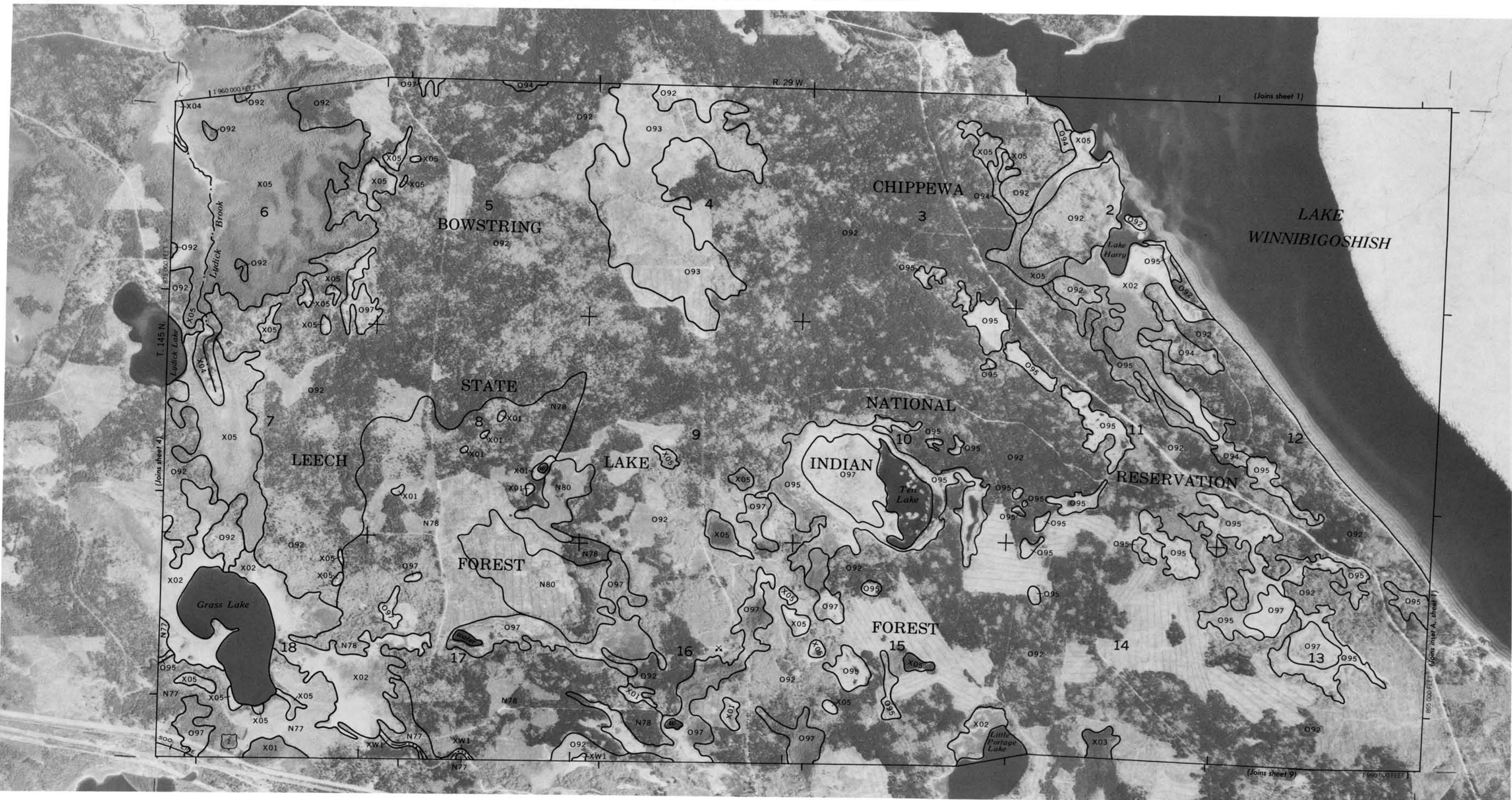




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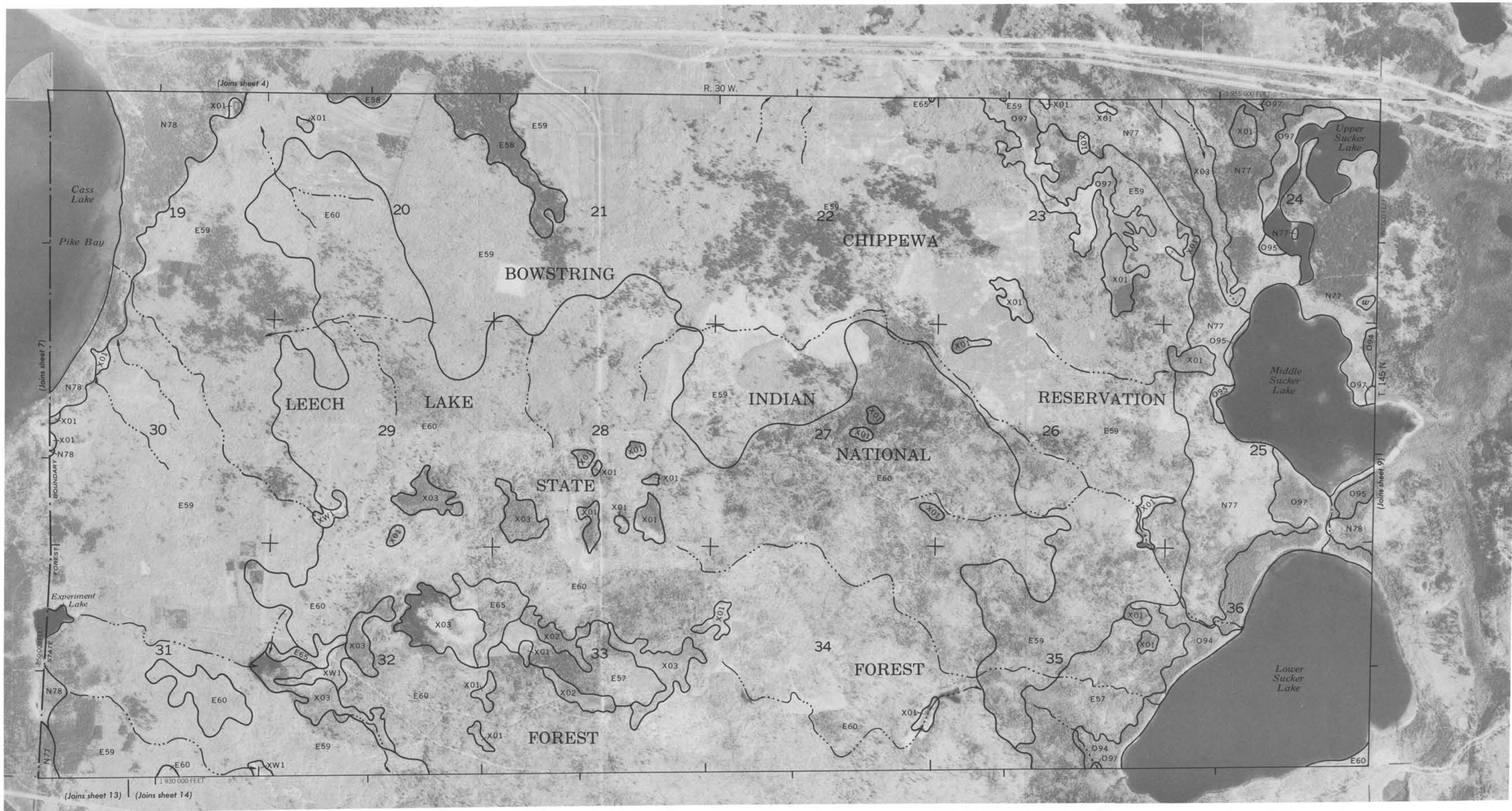
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(Joins sheet 8)



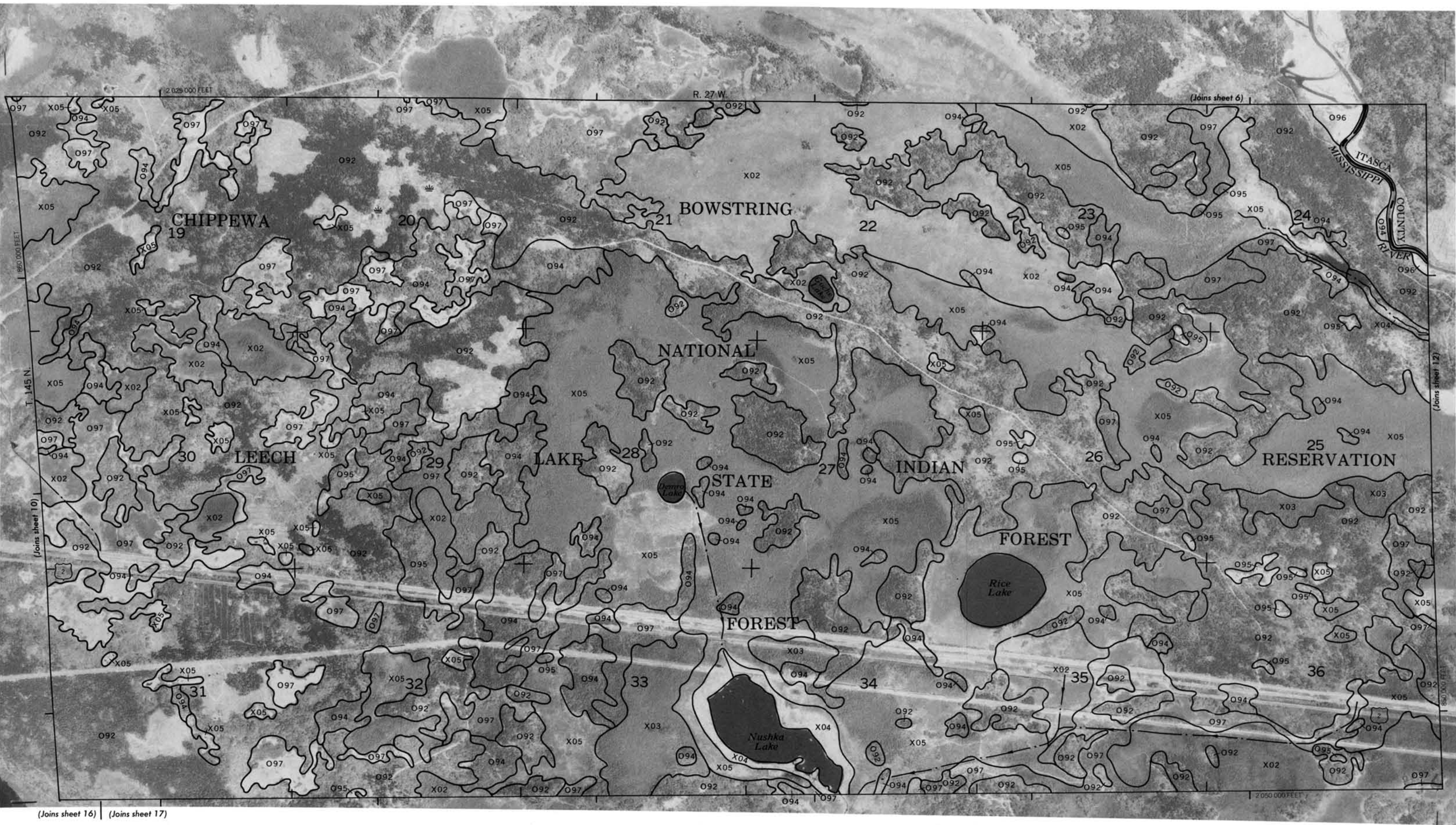


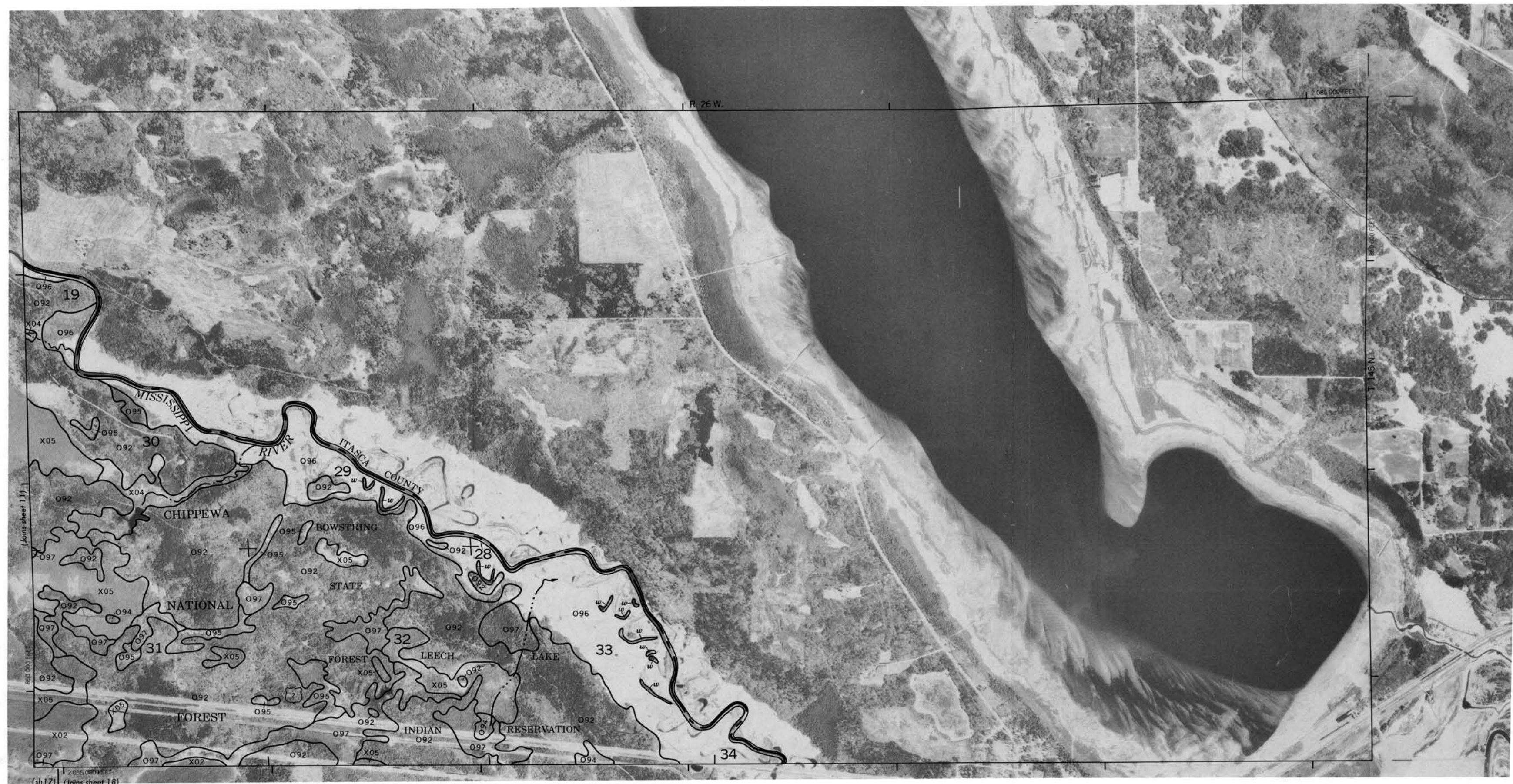






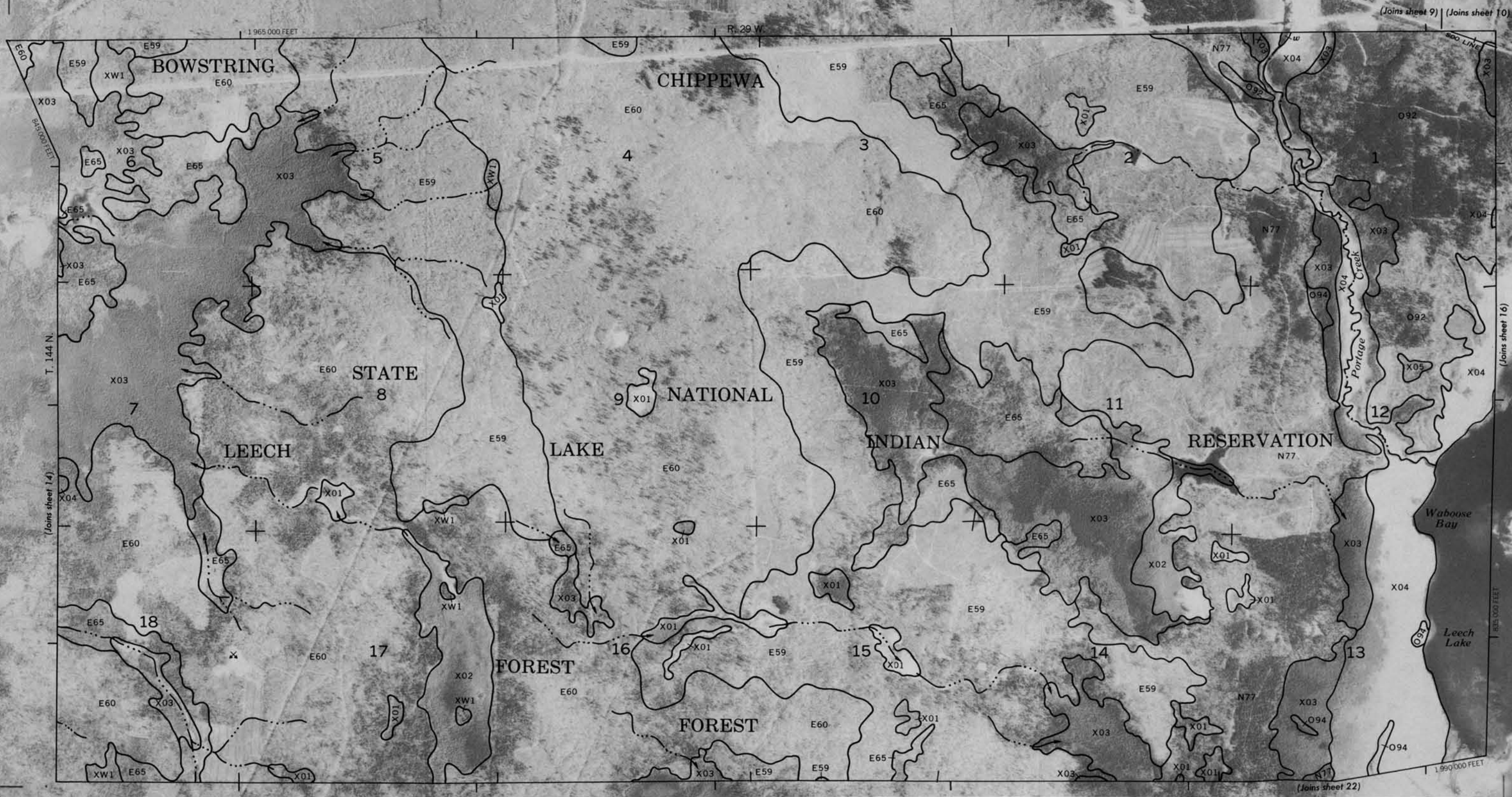


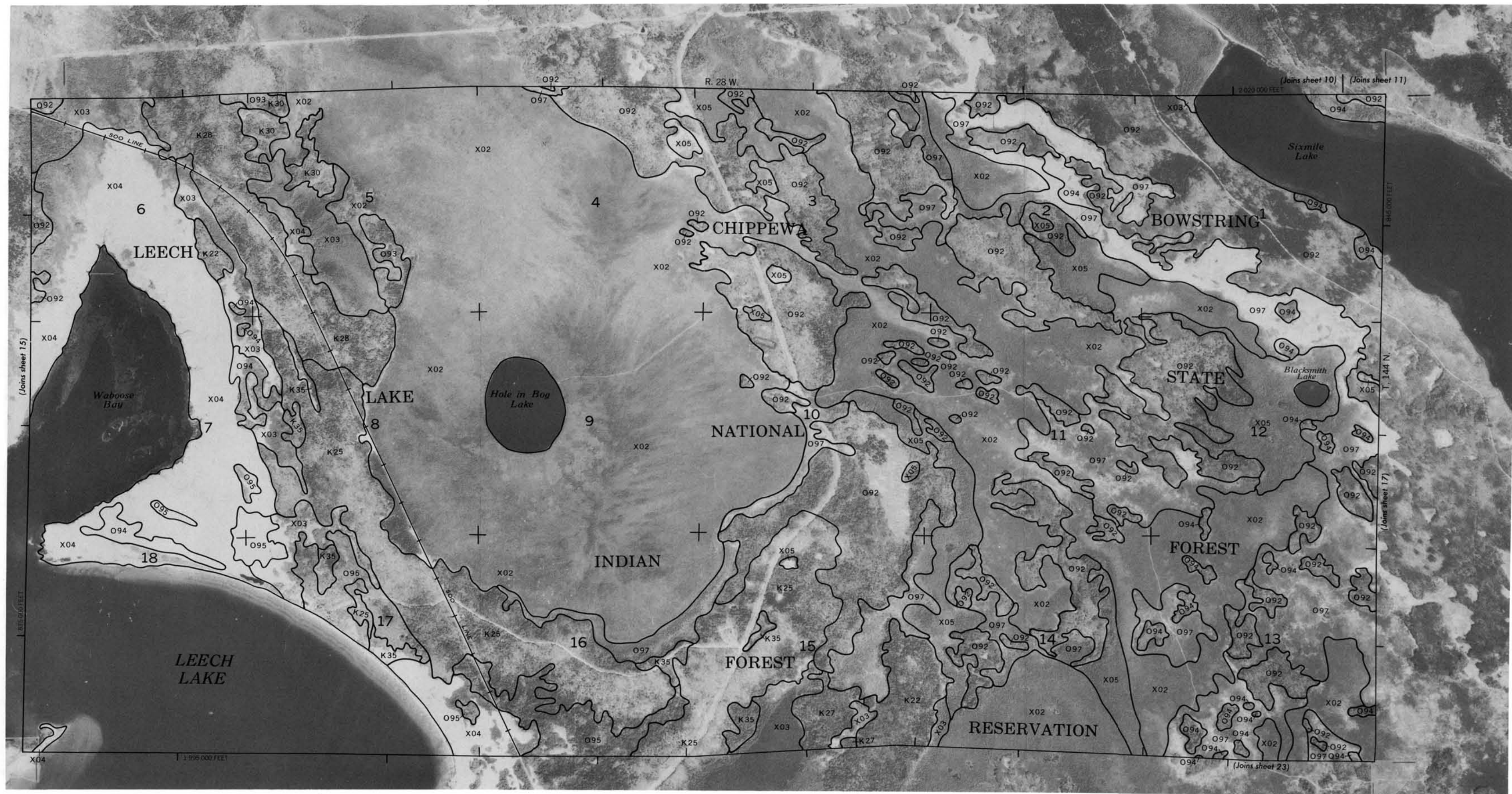




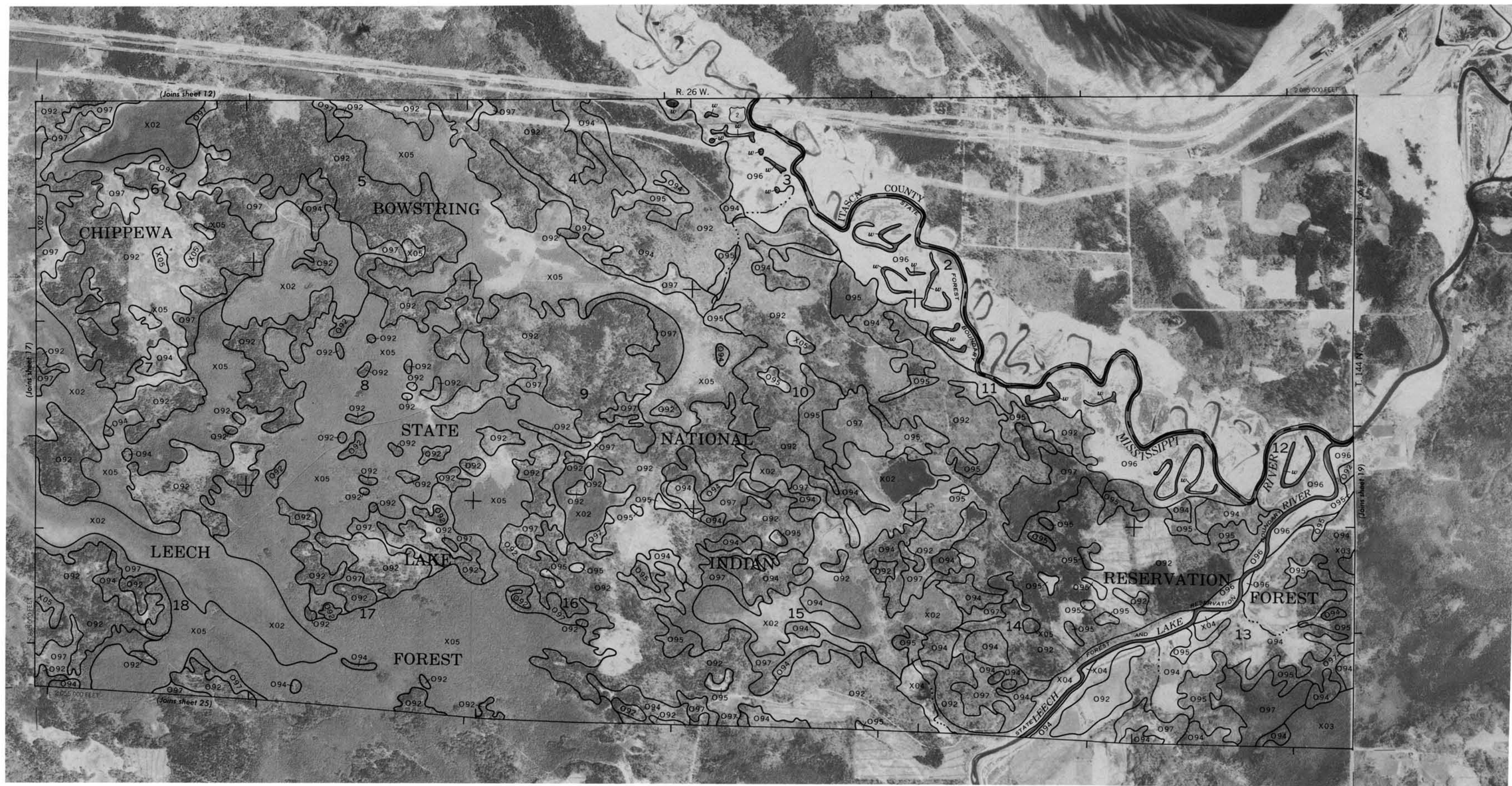


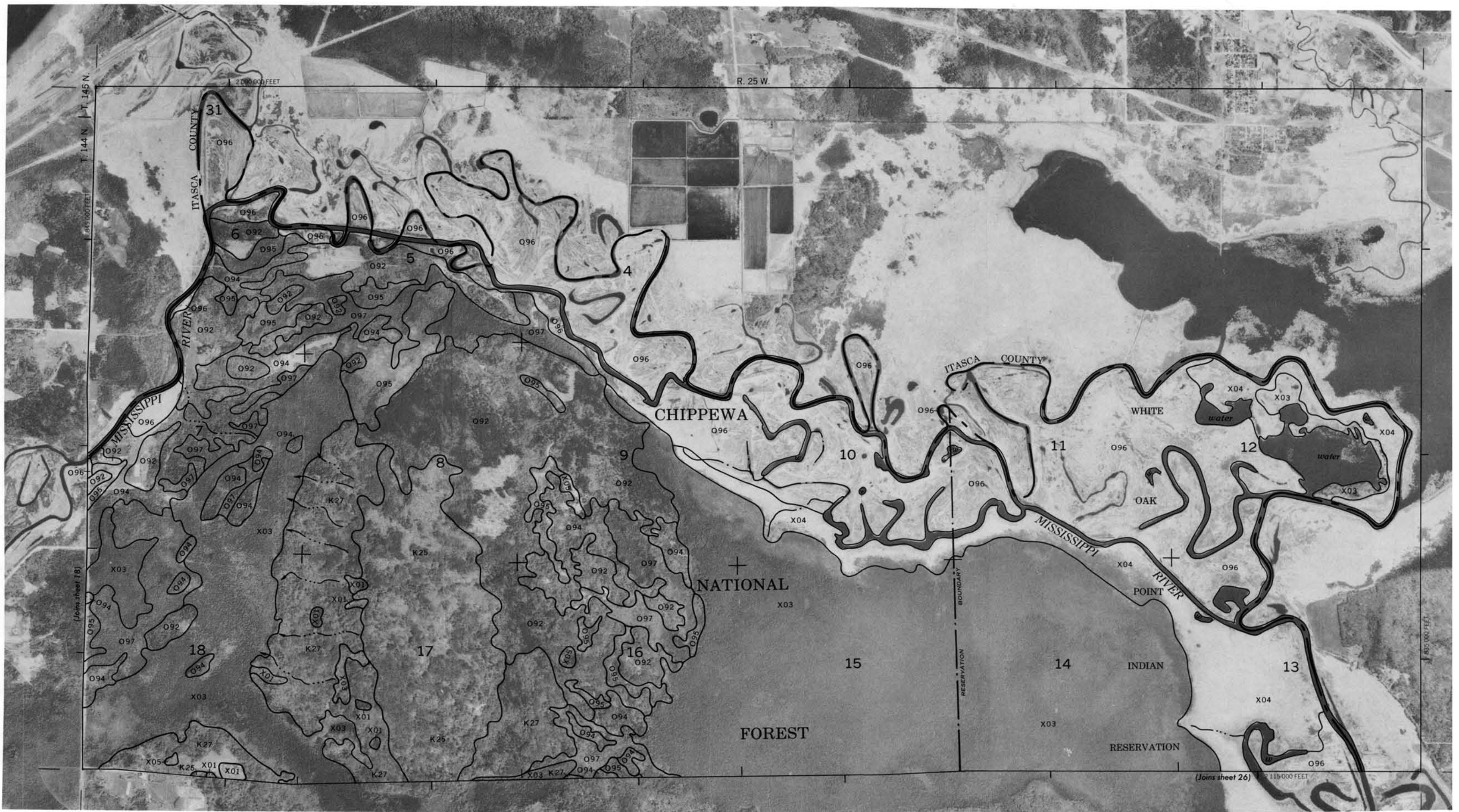






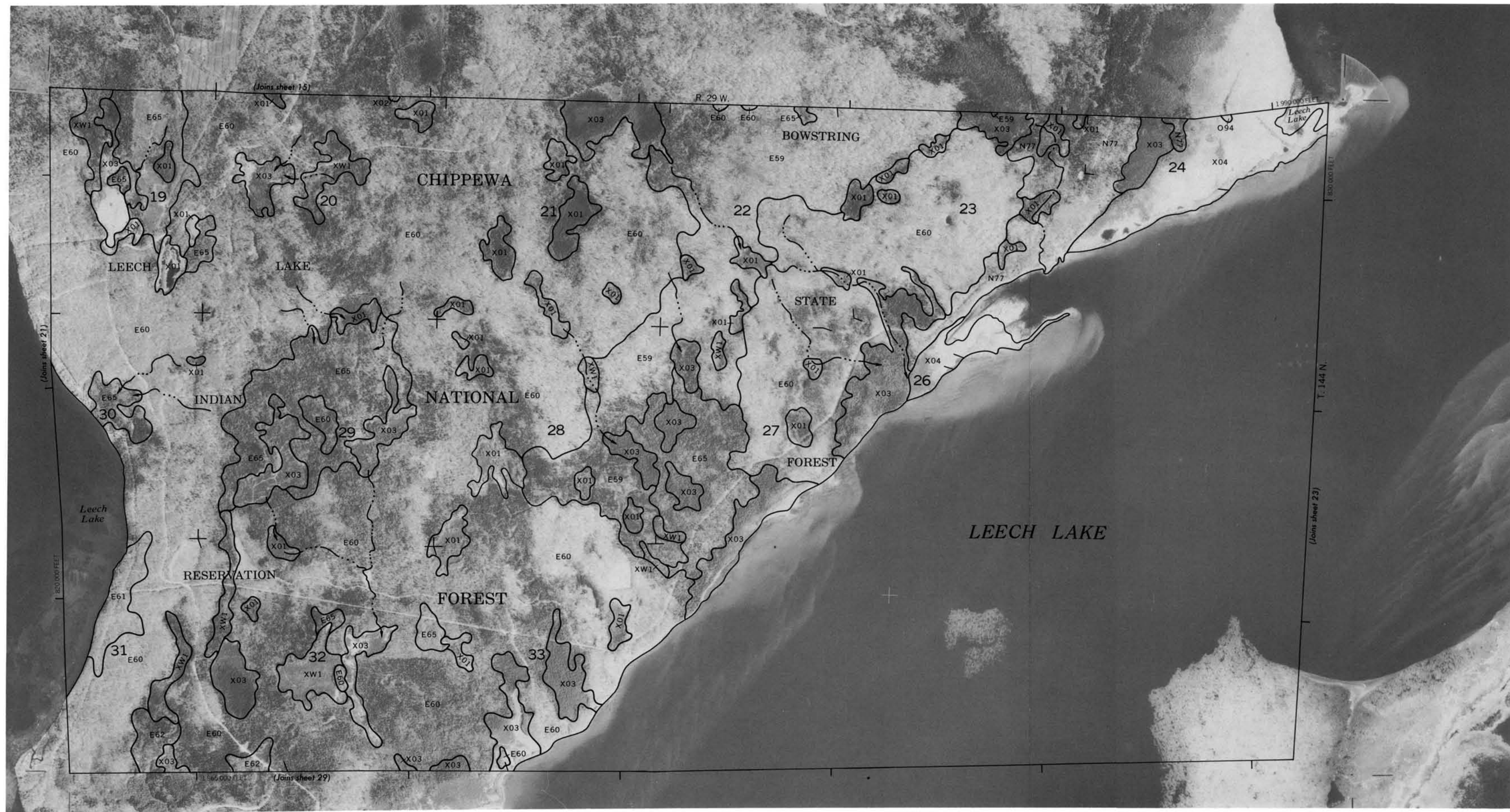




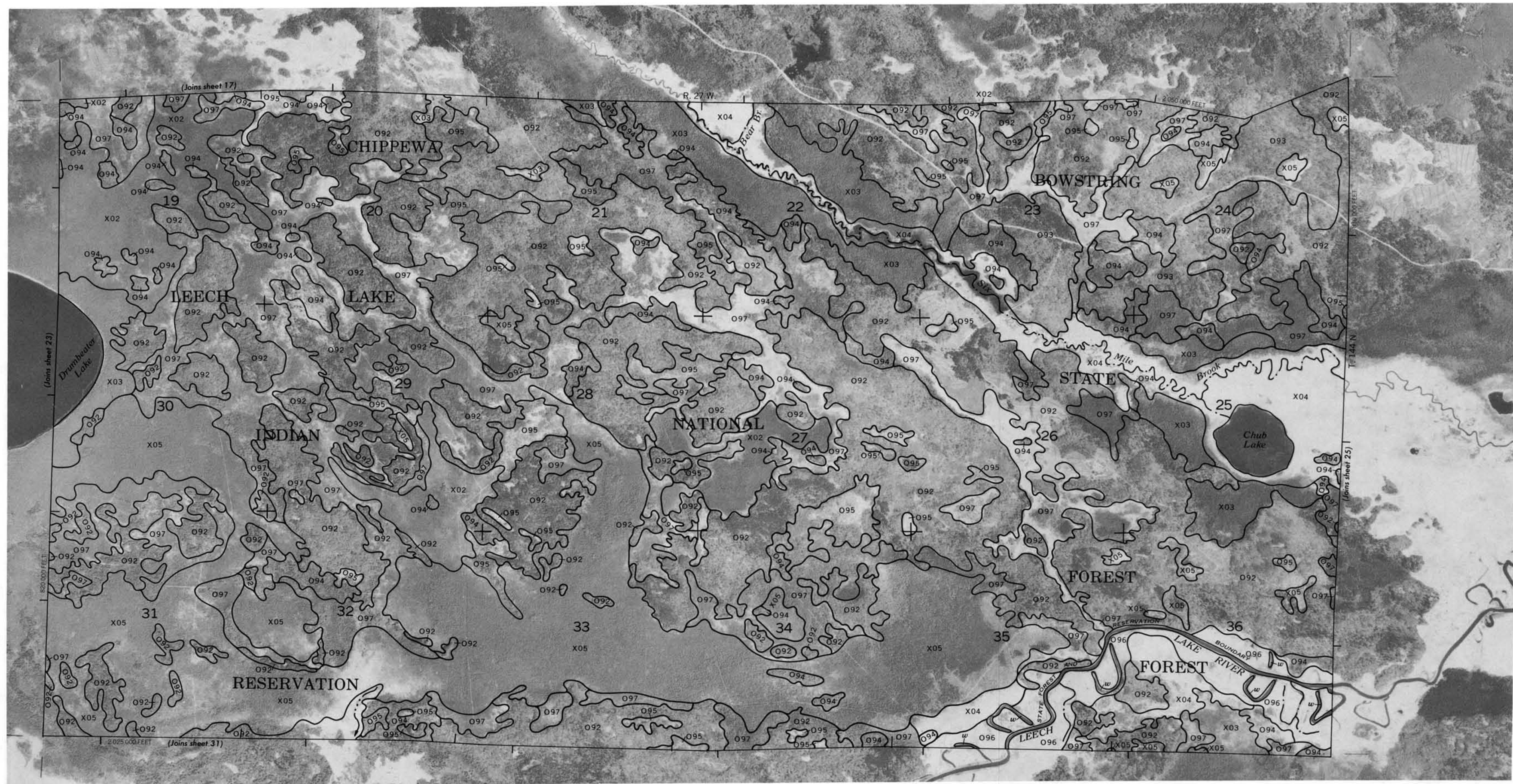








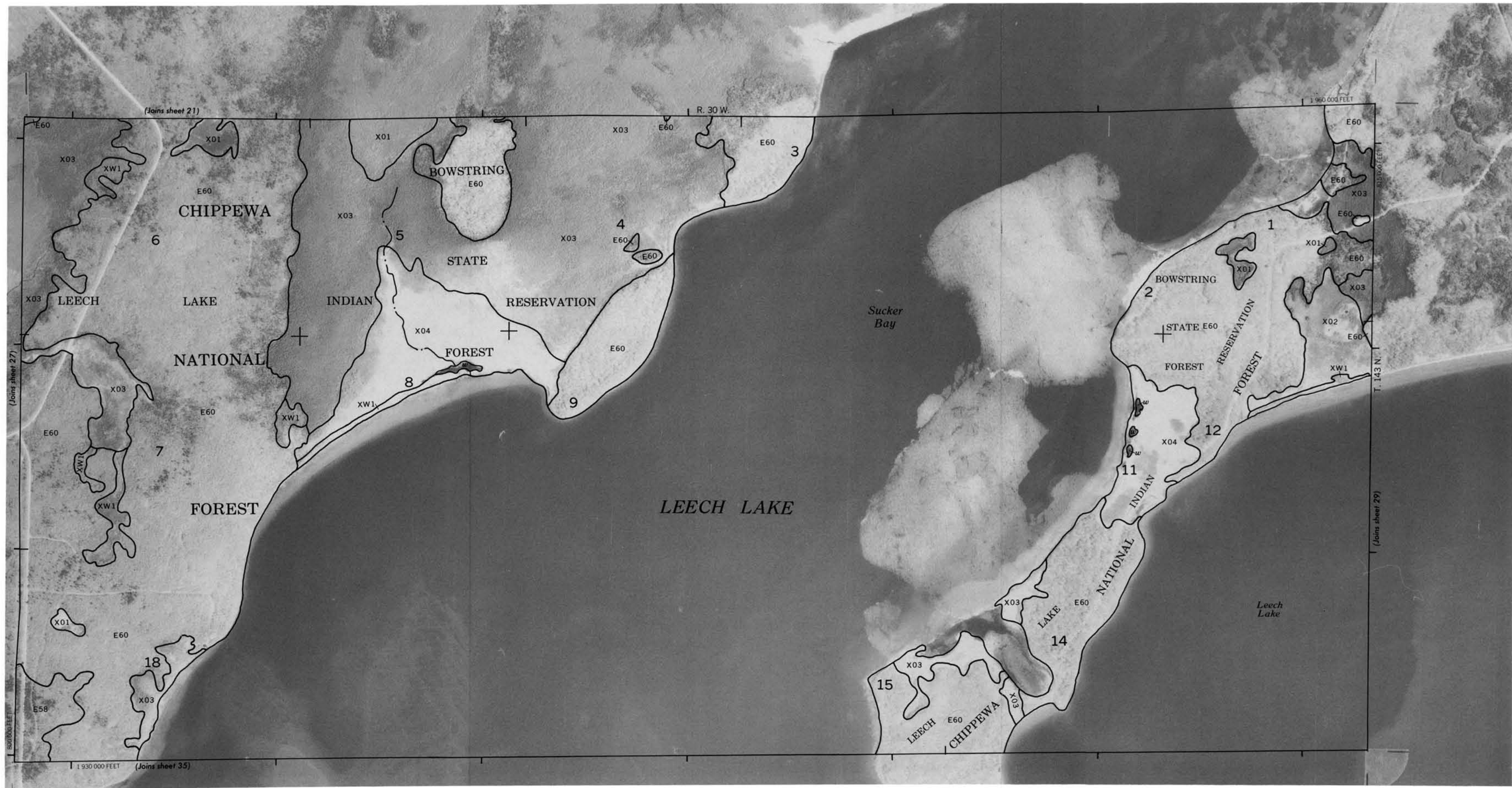


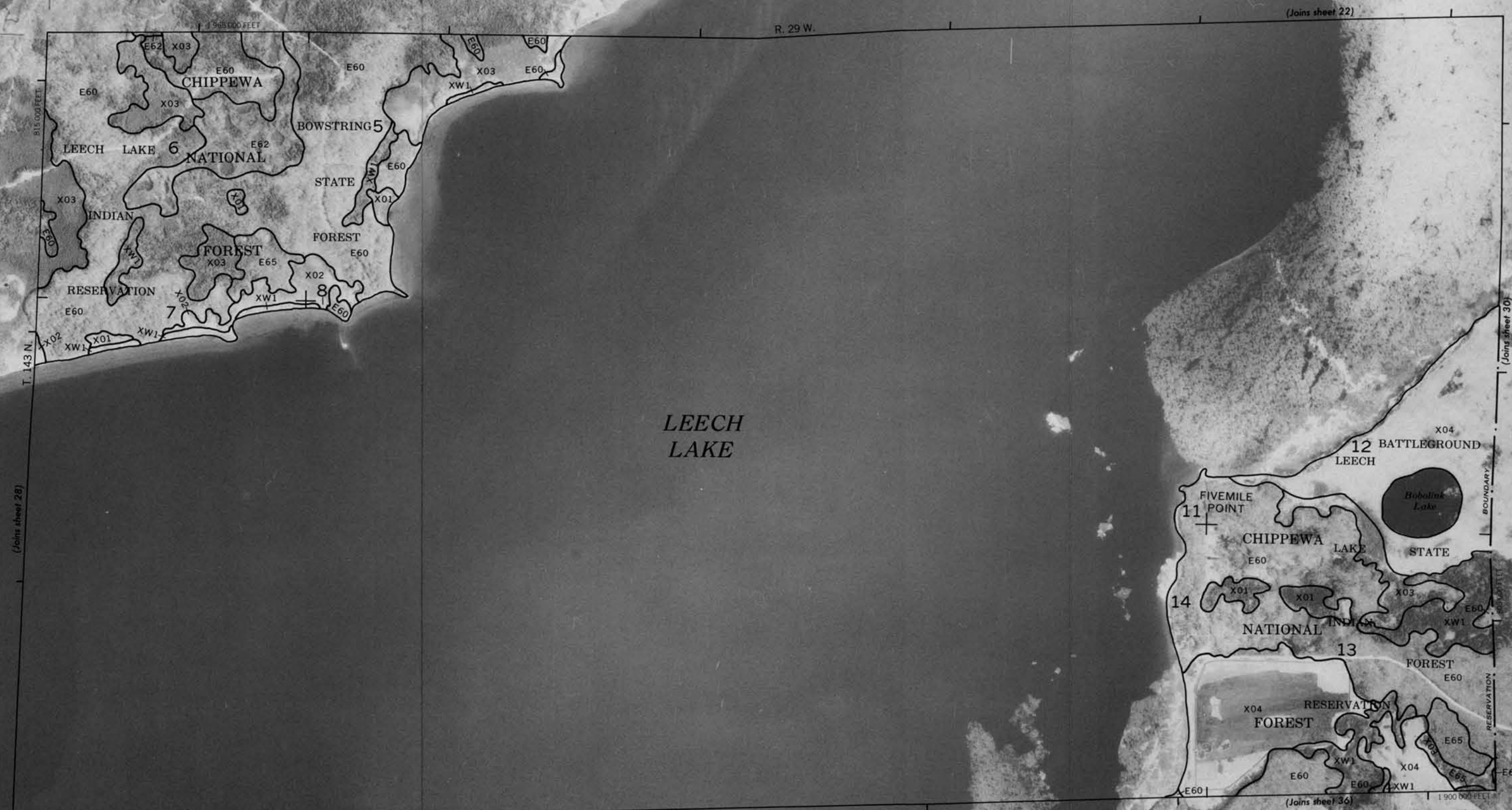






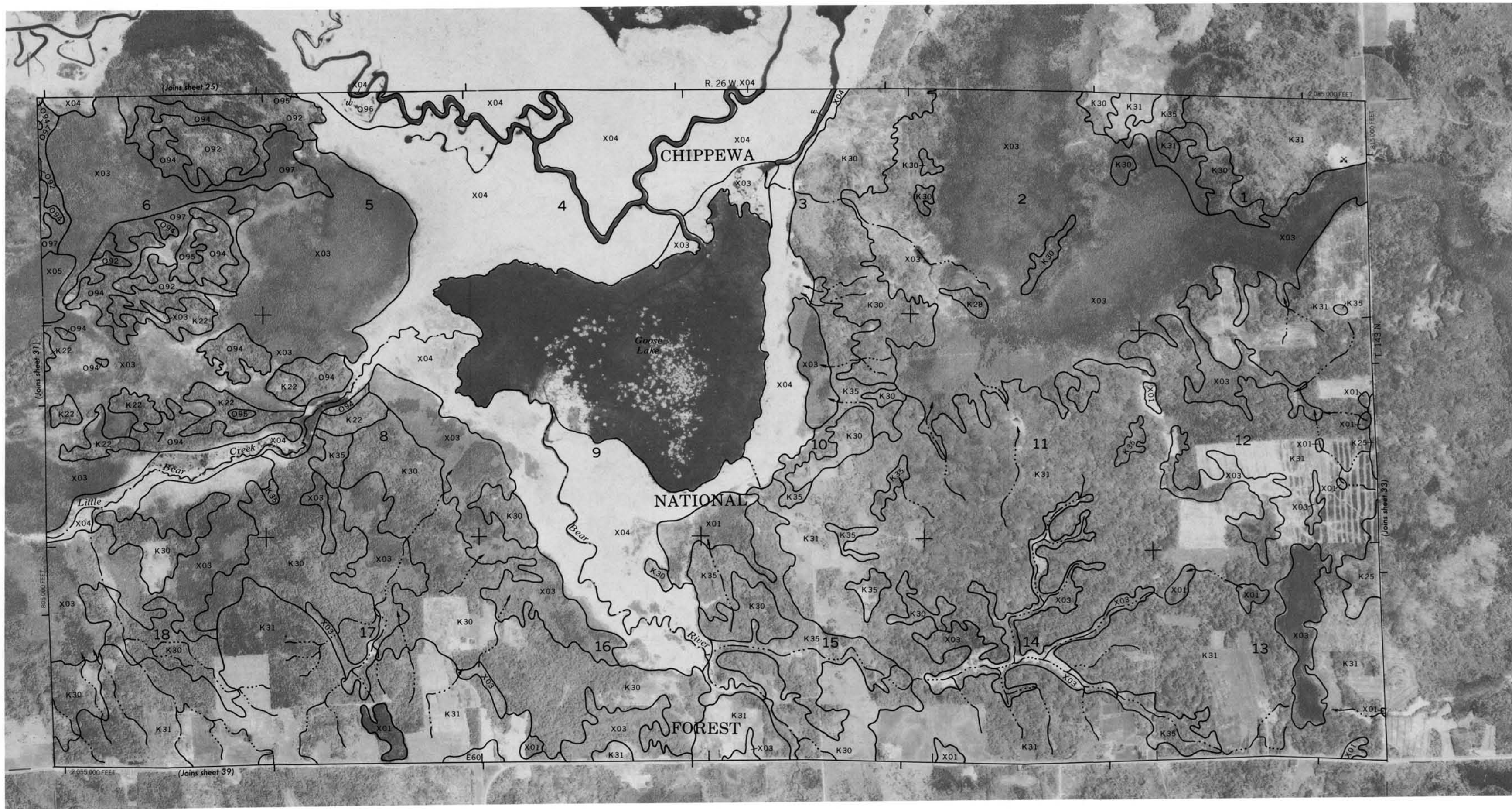






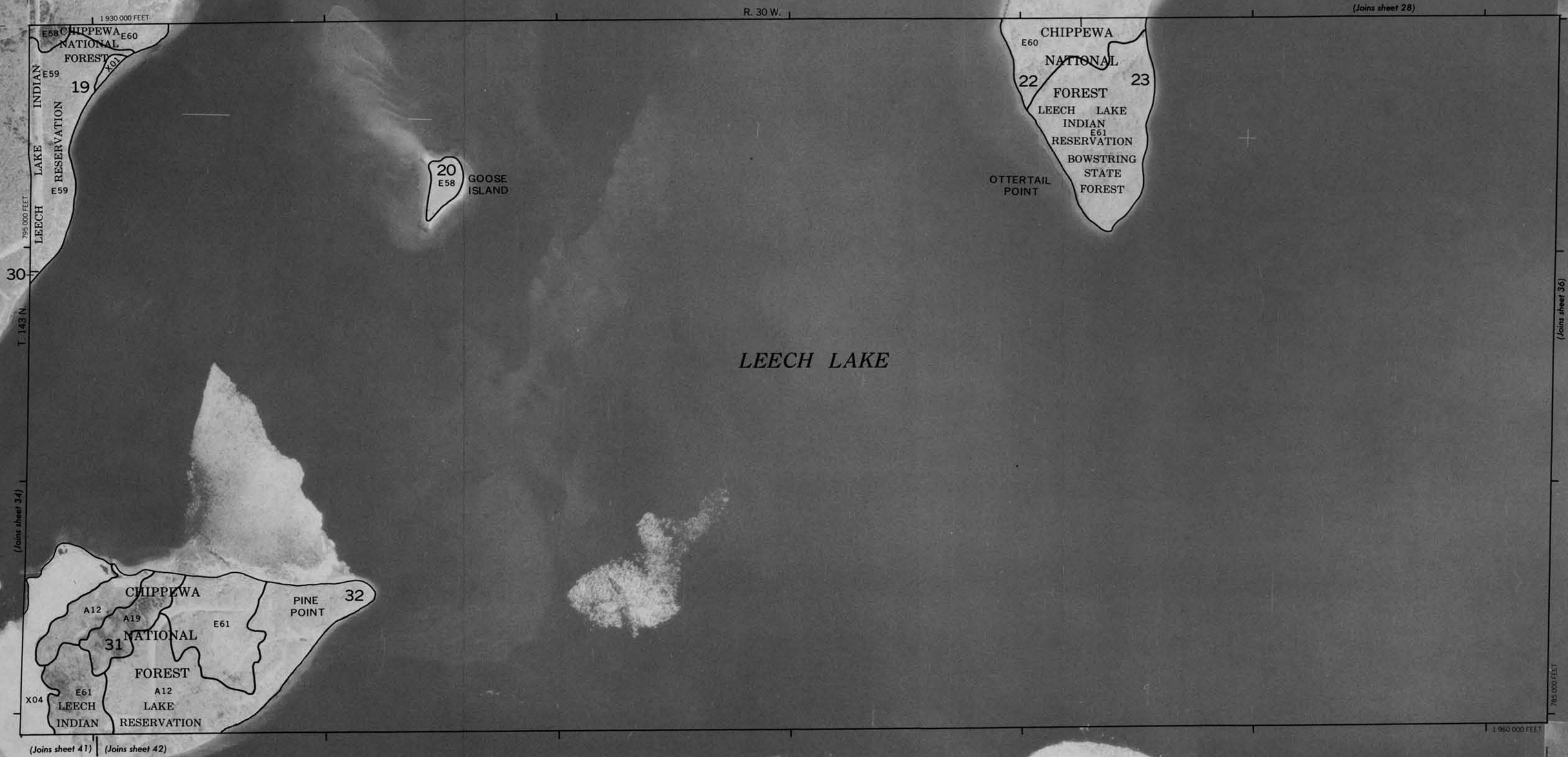


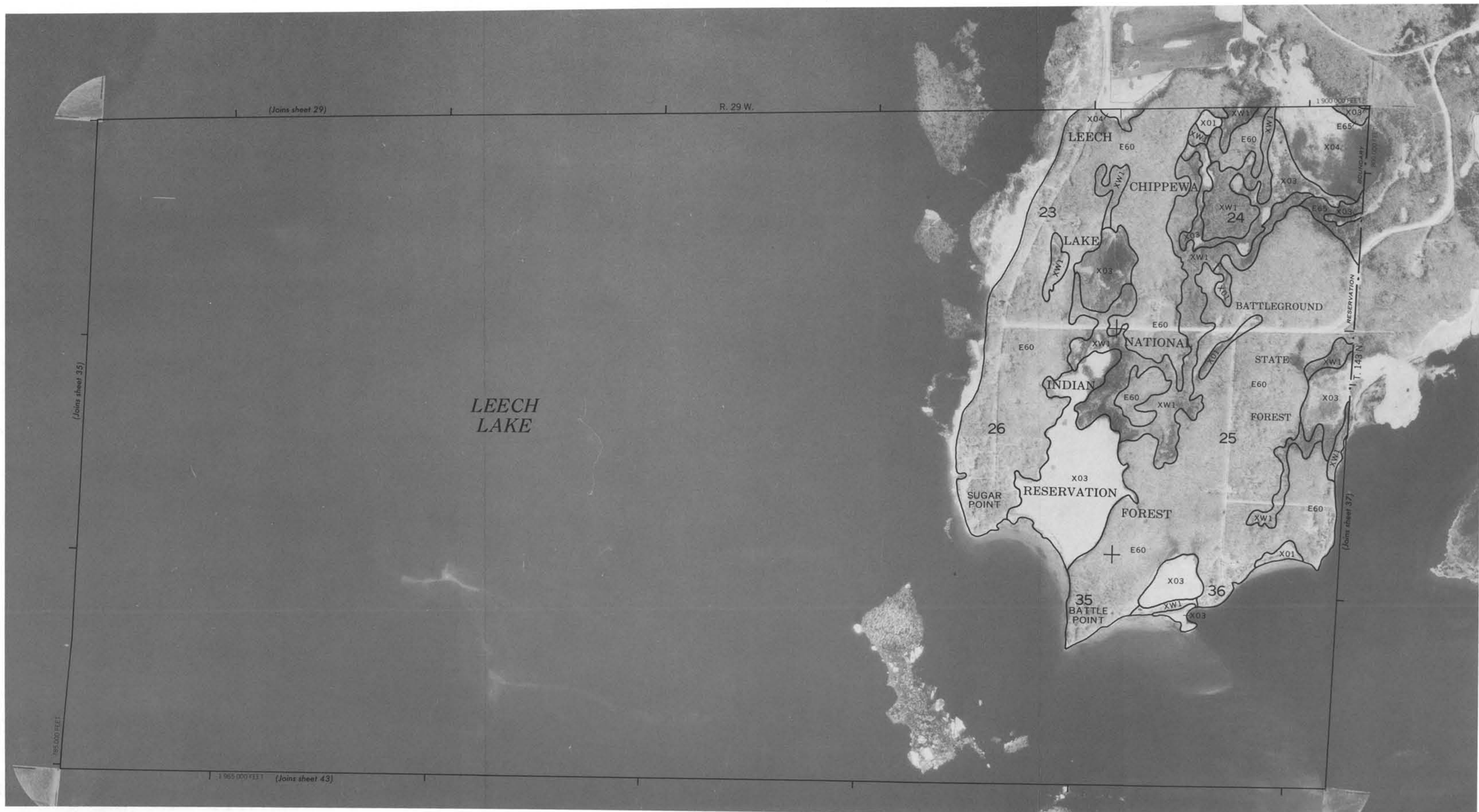








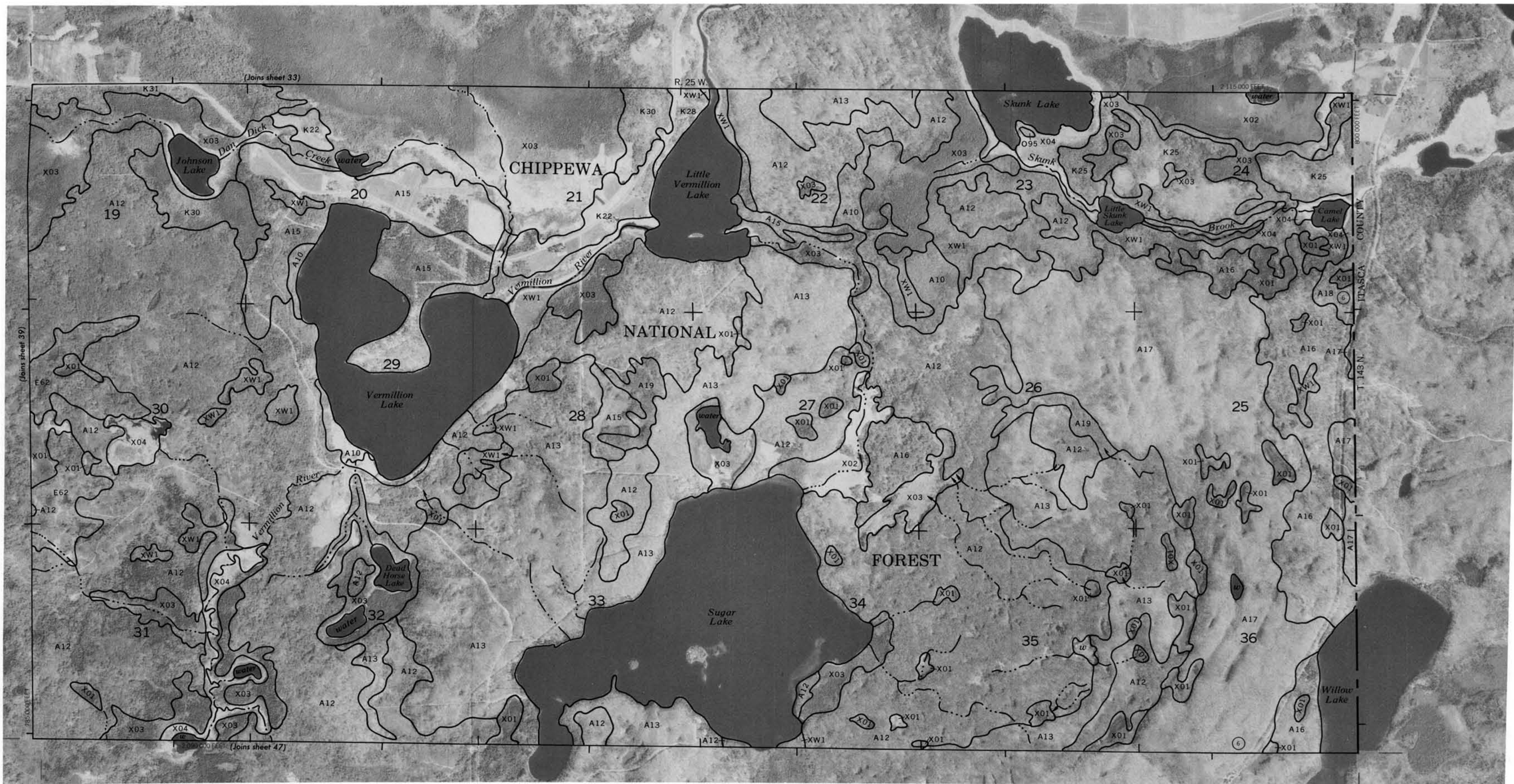




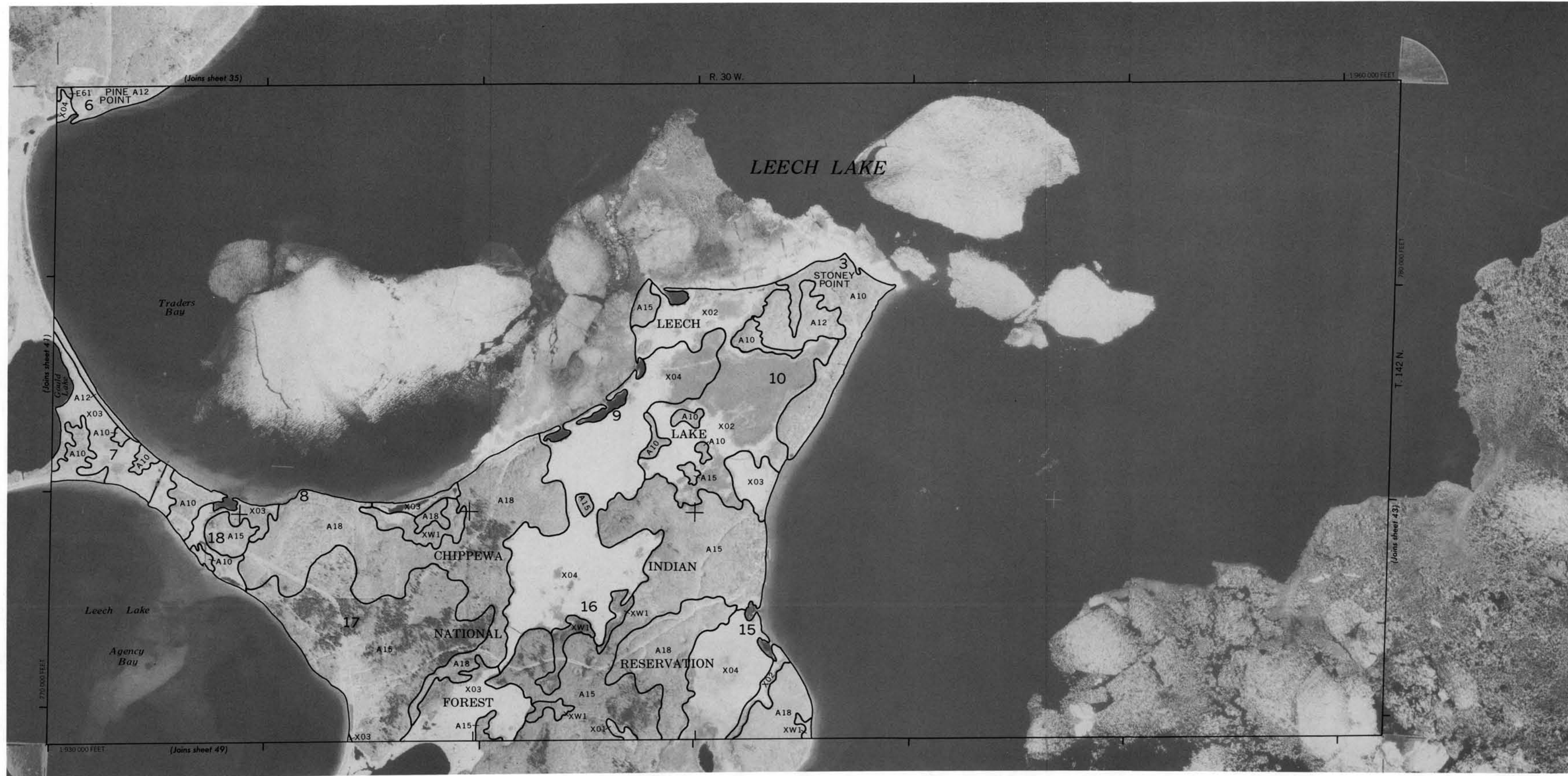


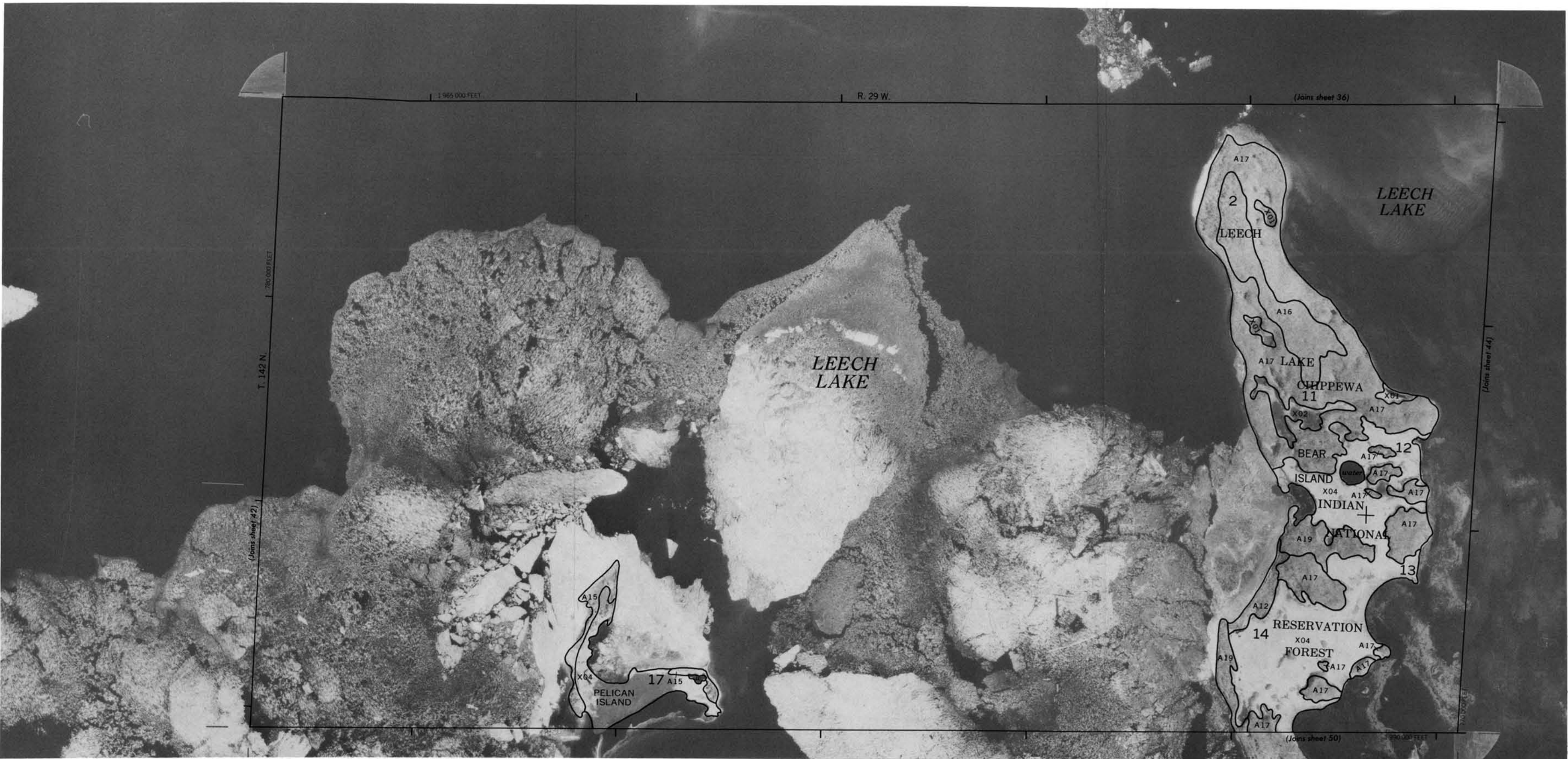






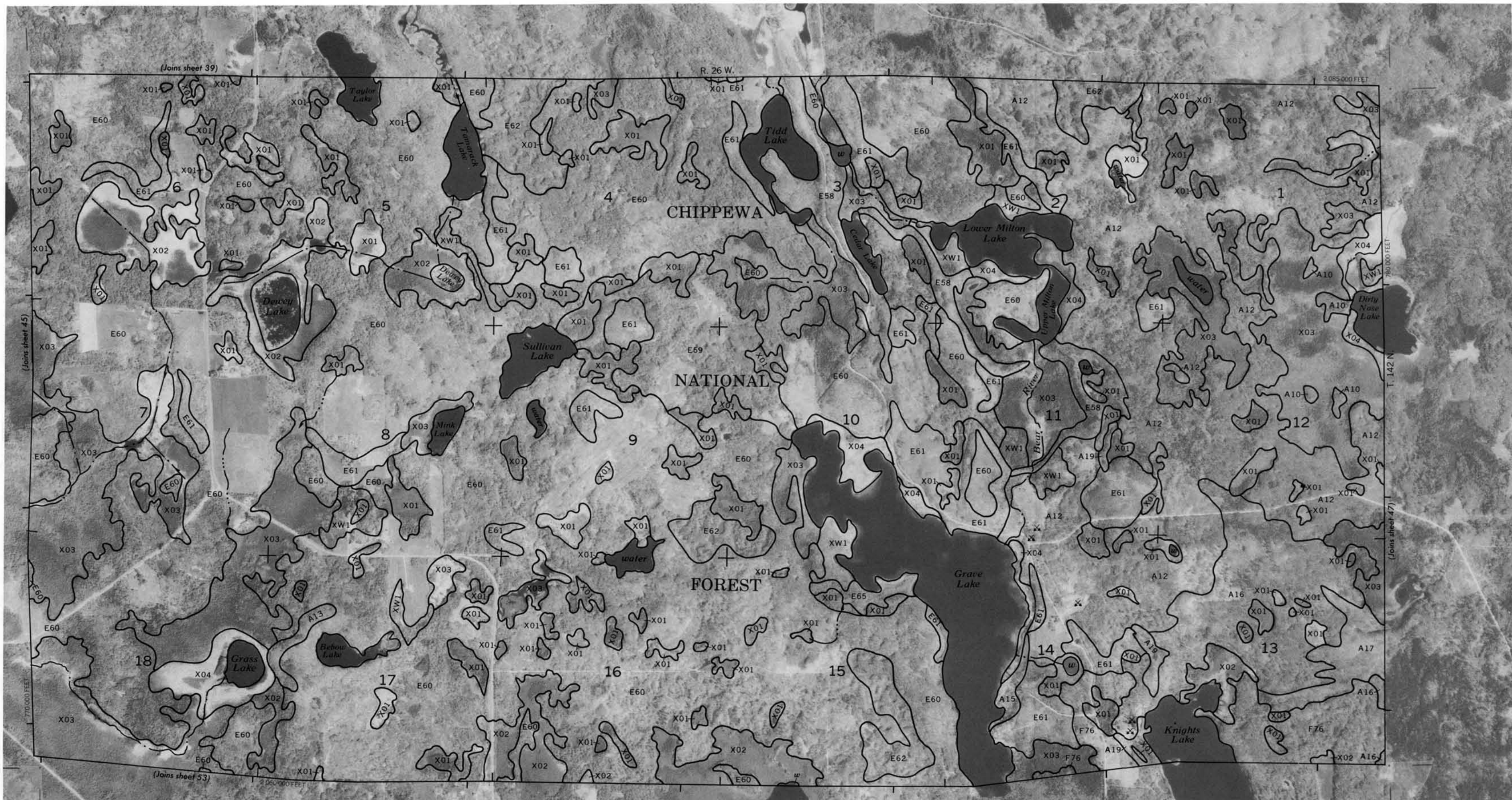






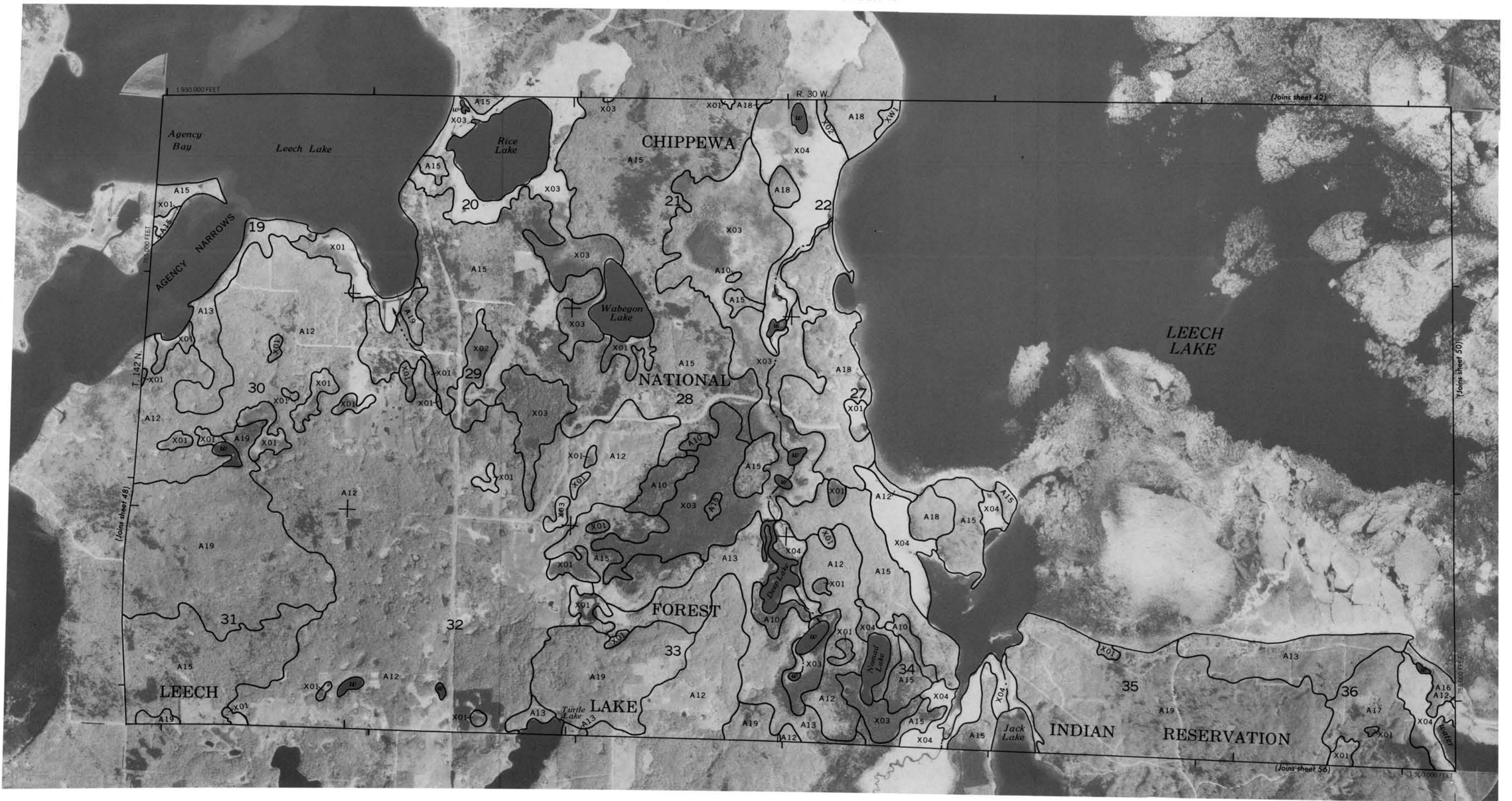


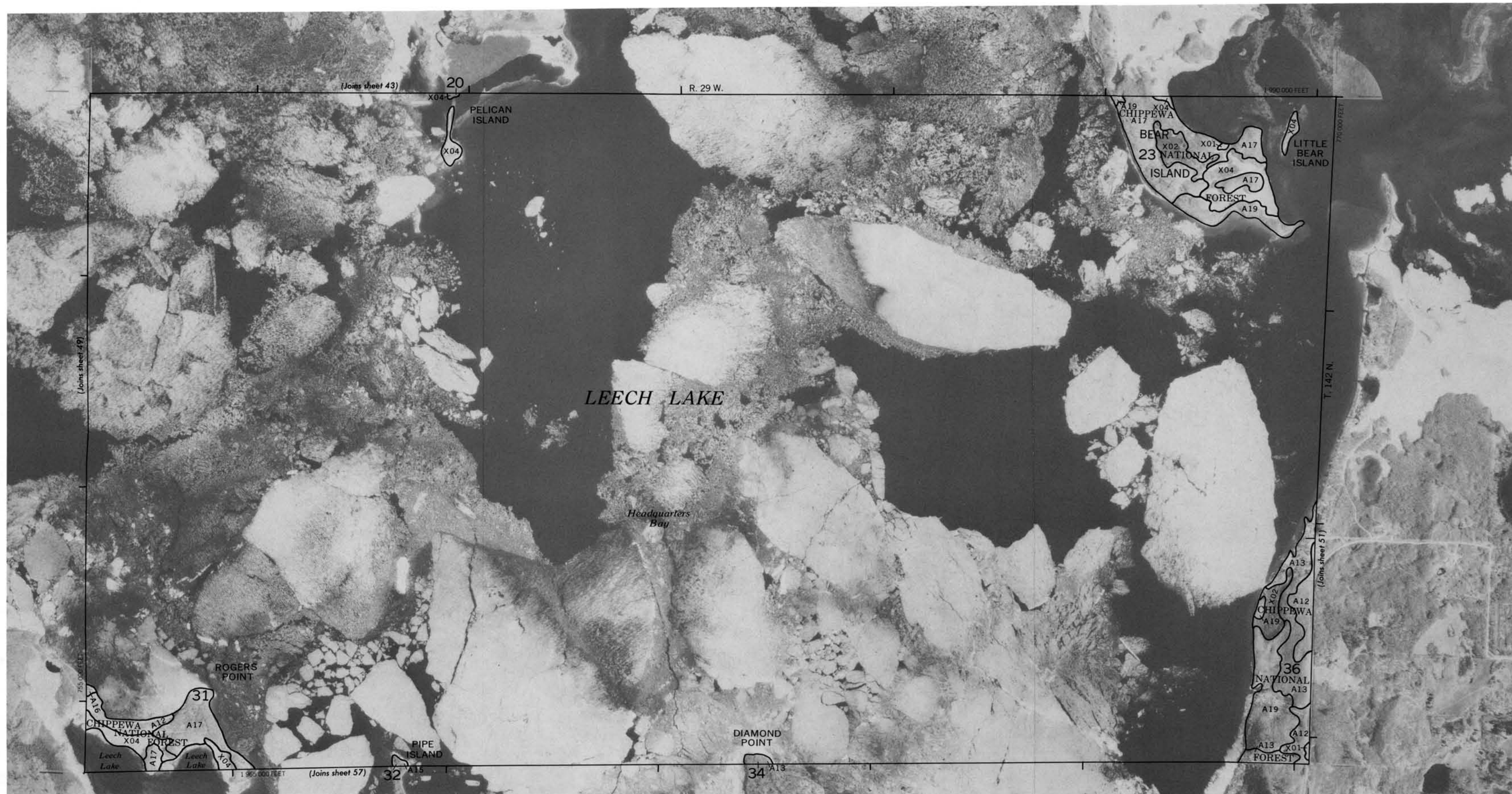






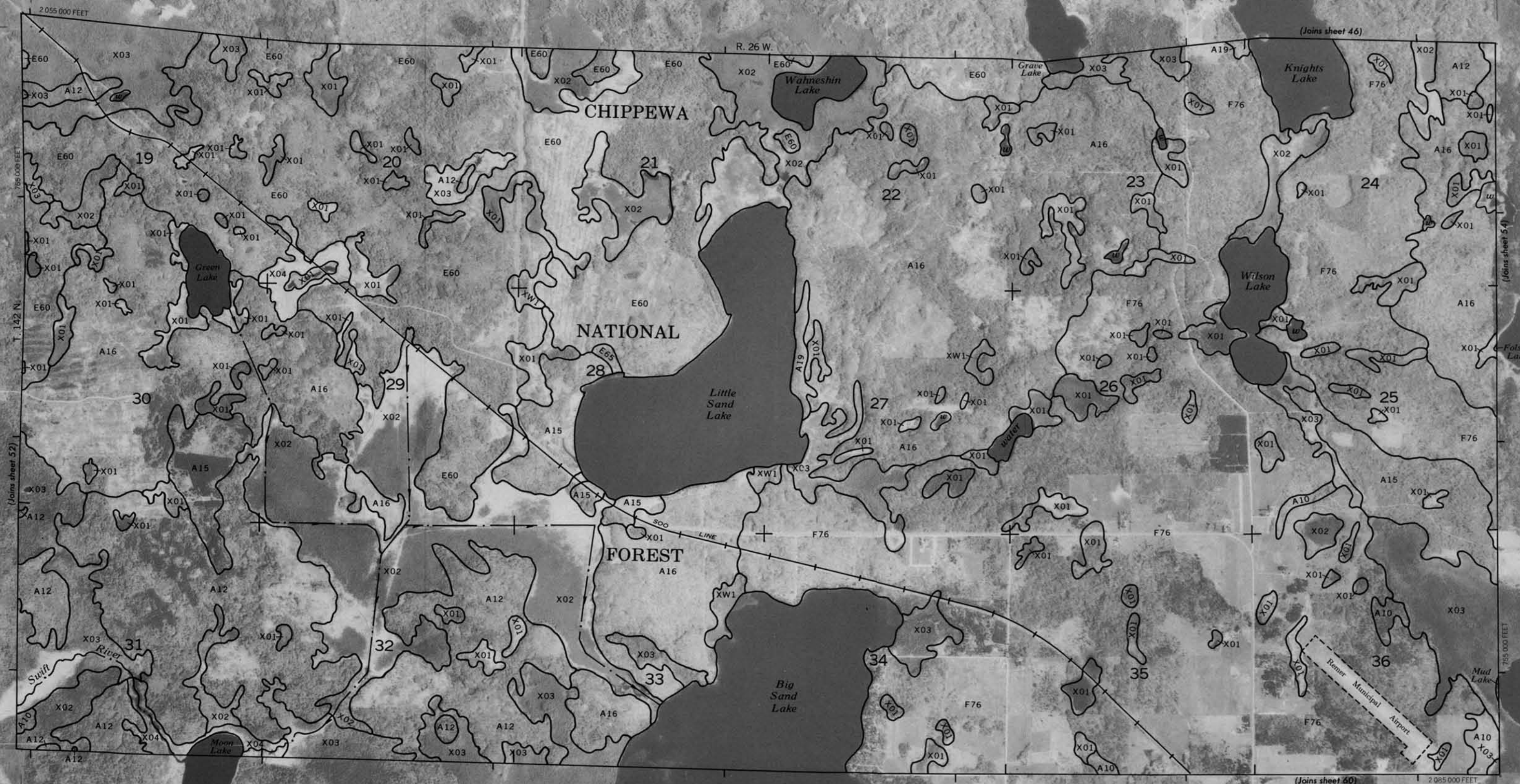




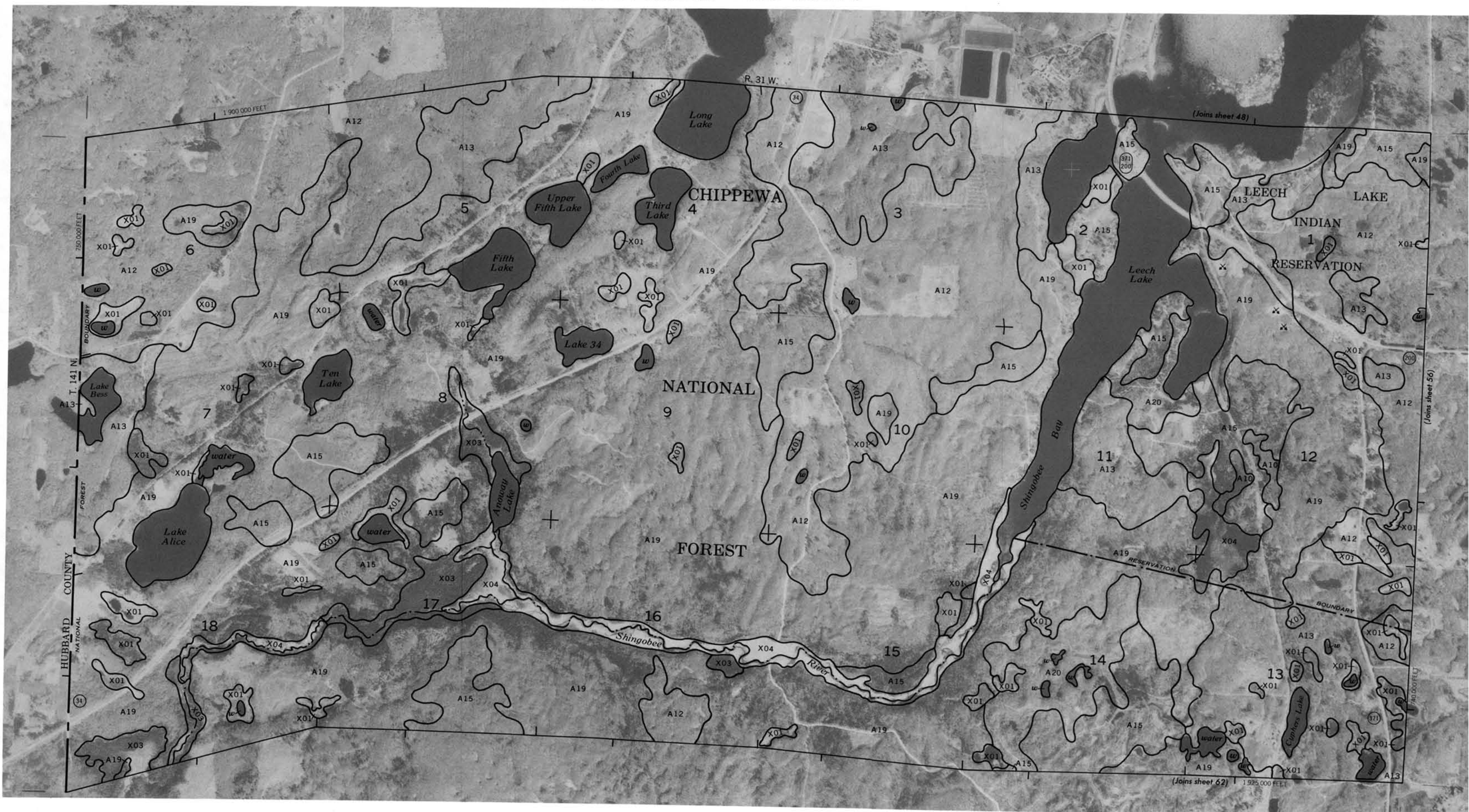




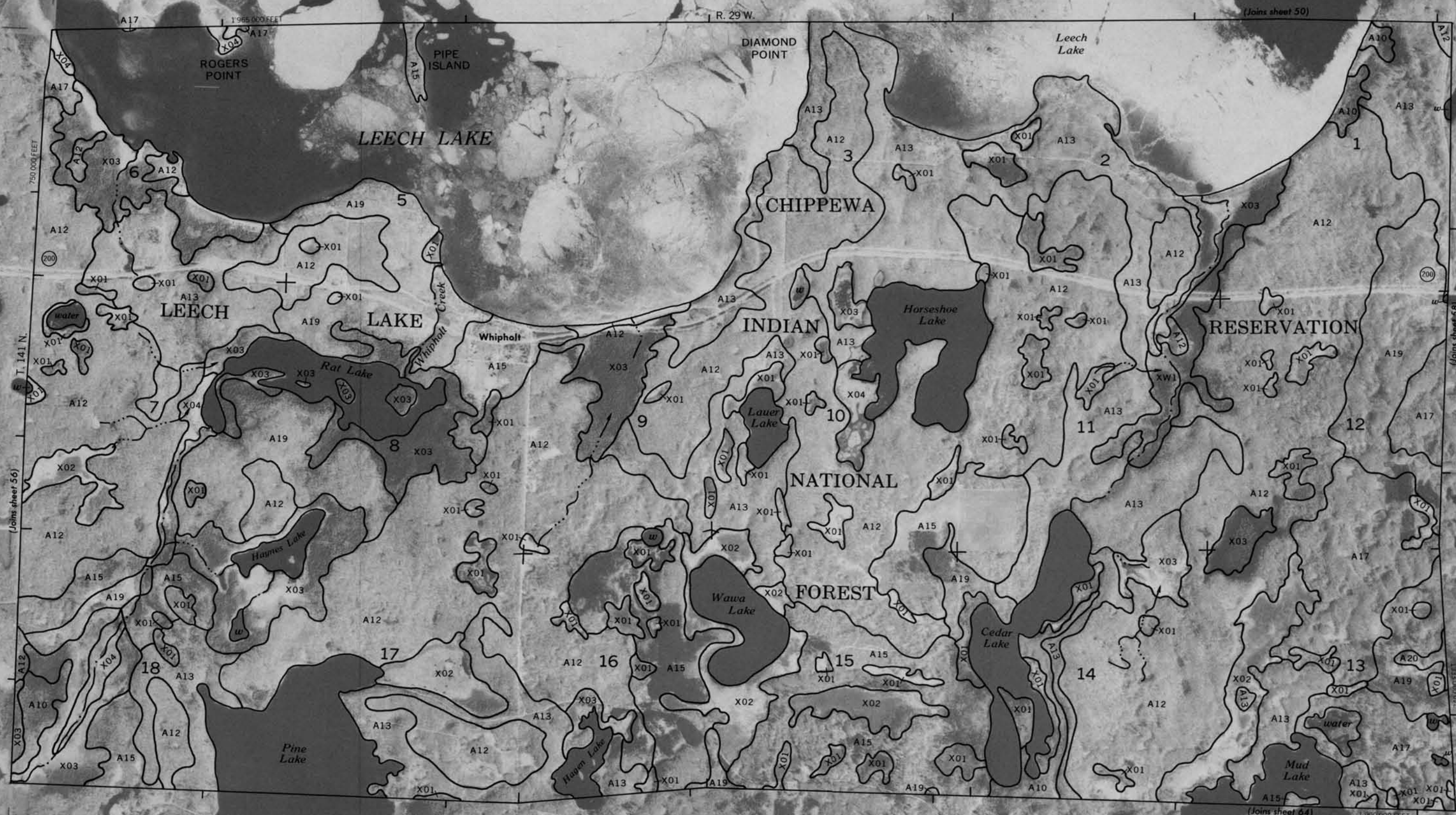






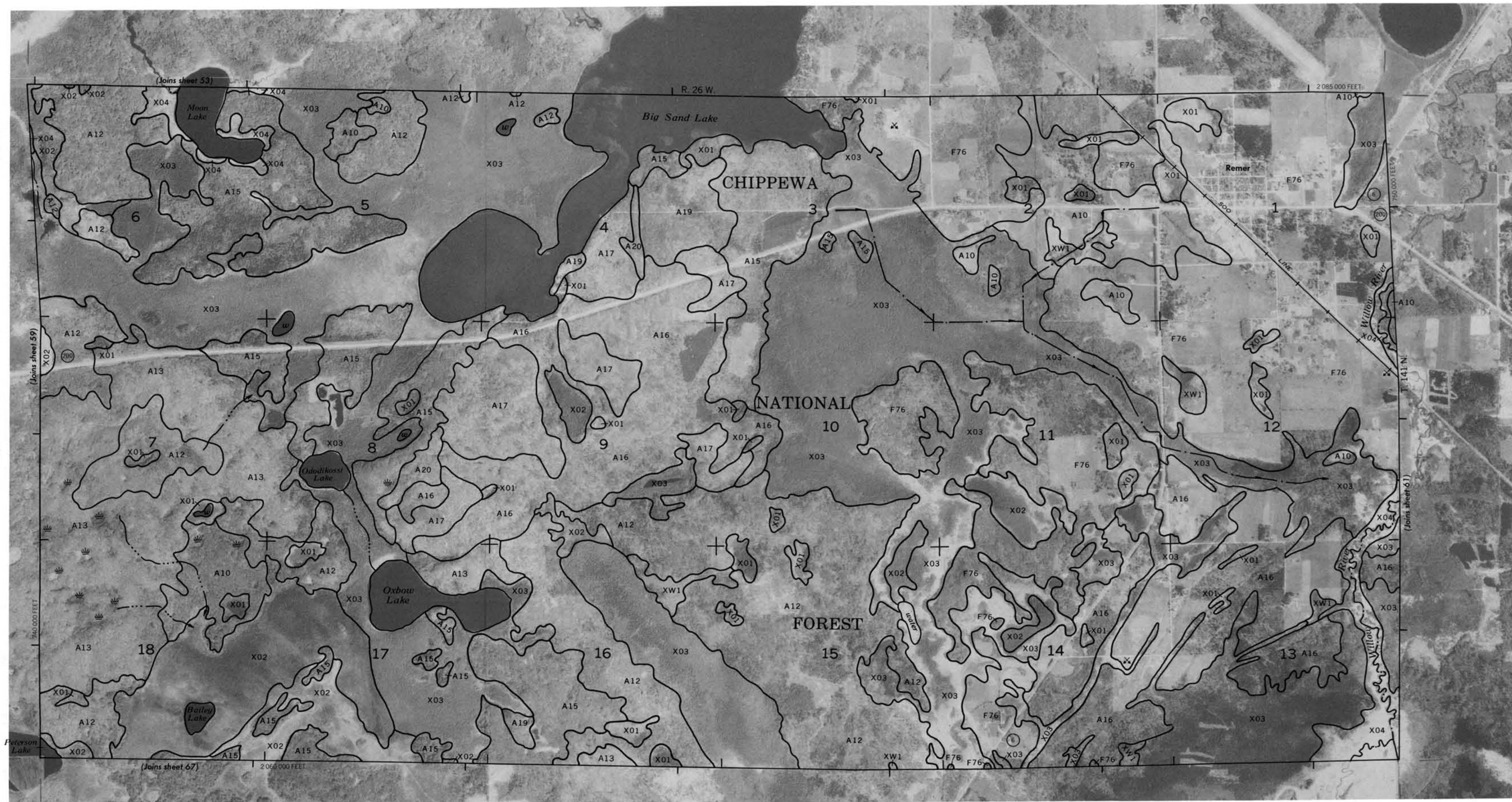




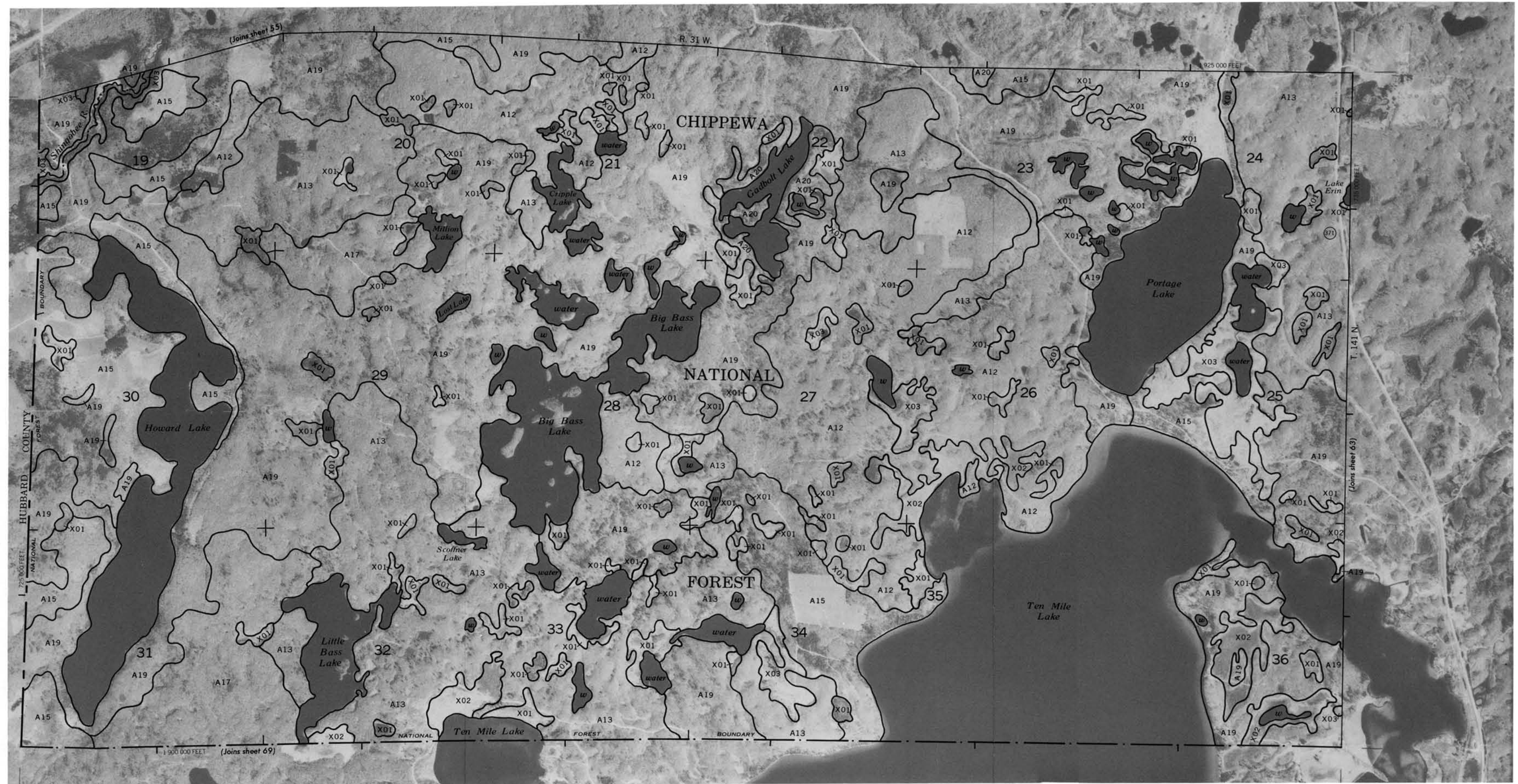




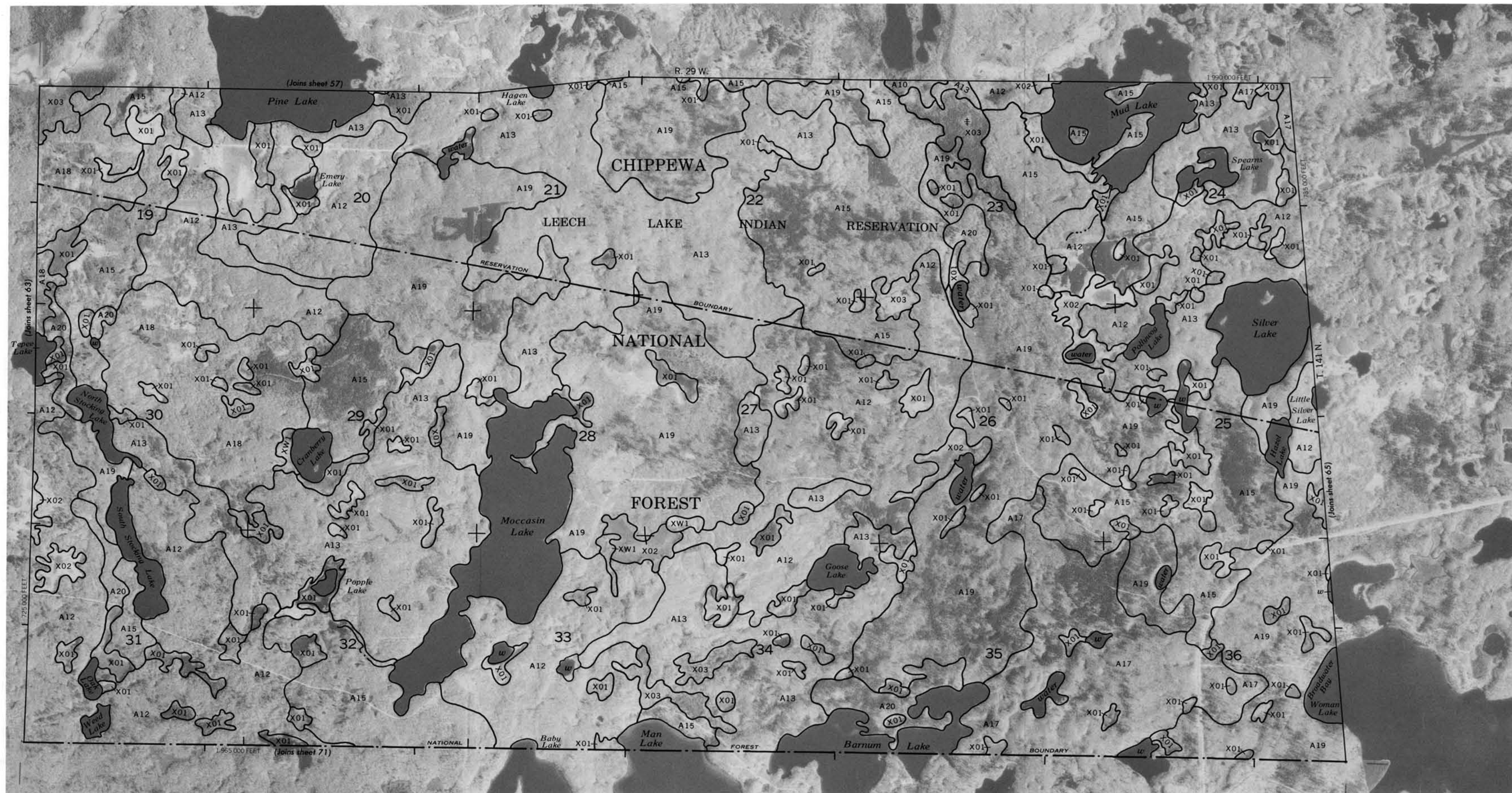




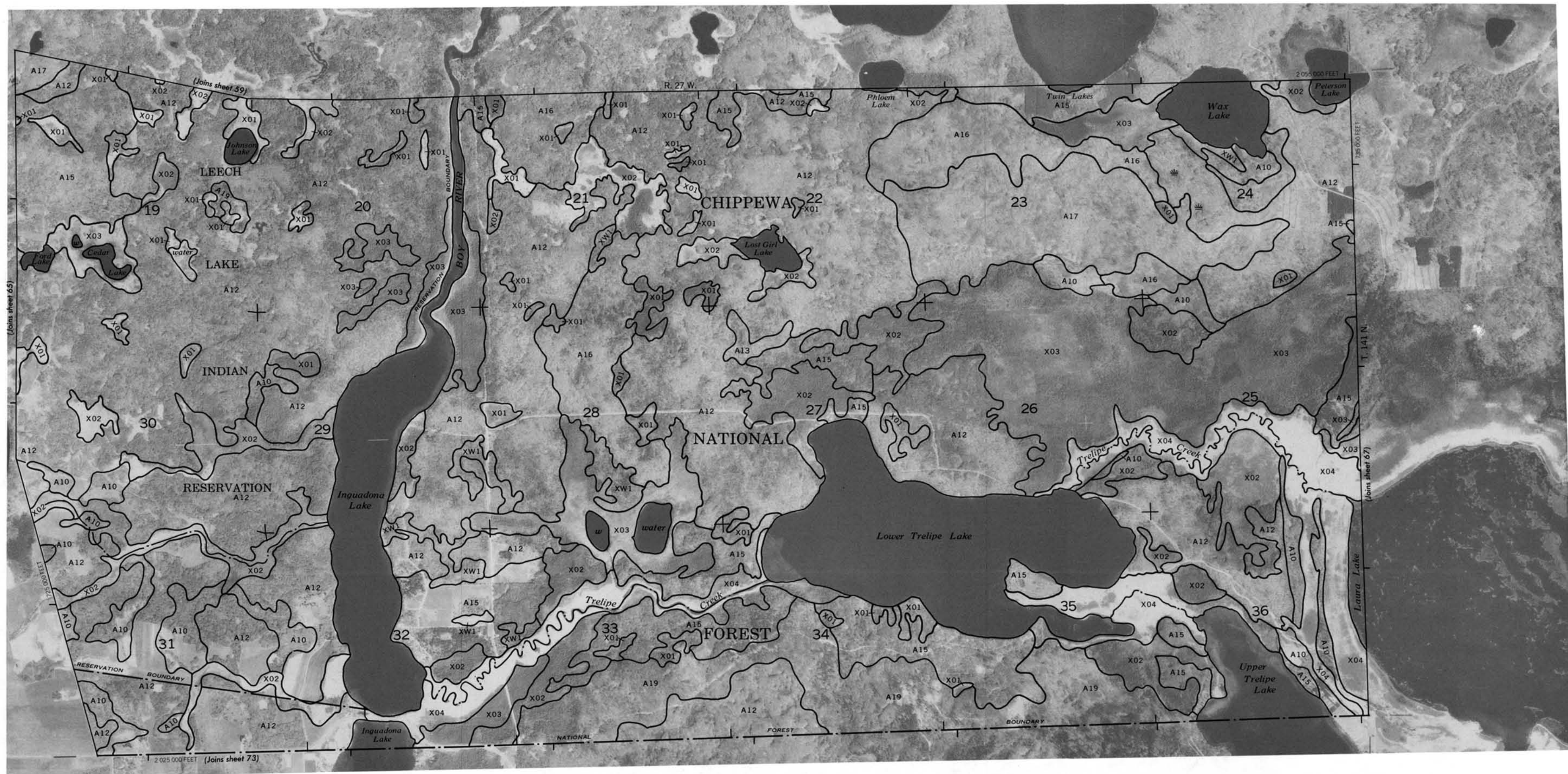




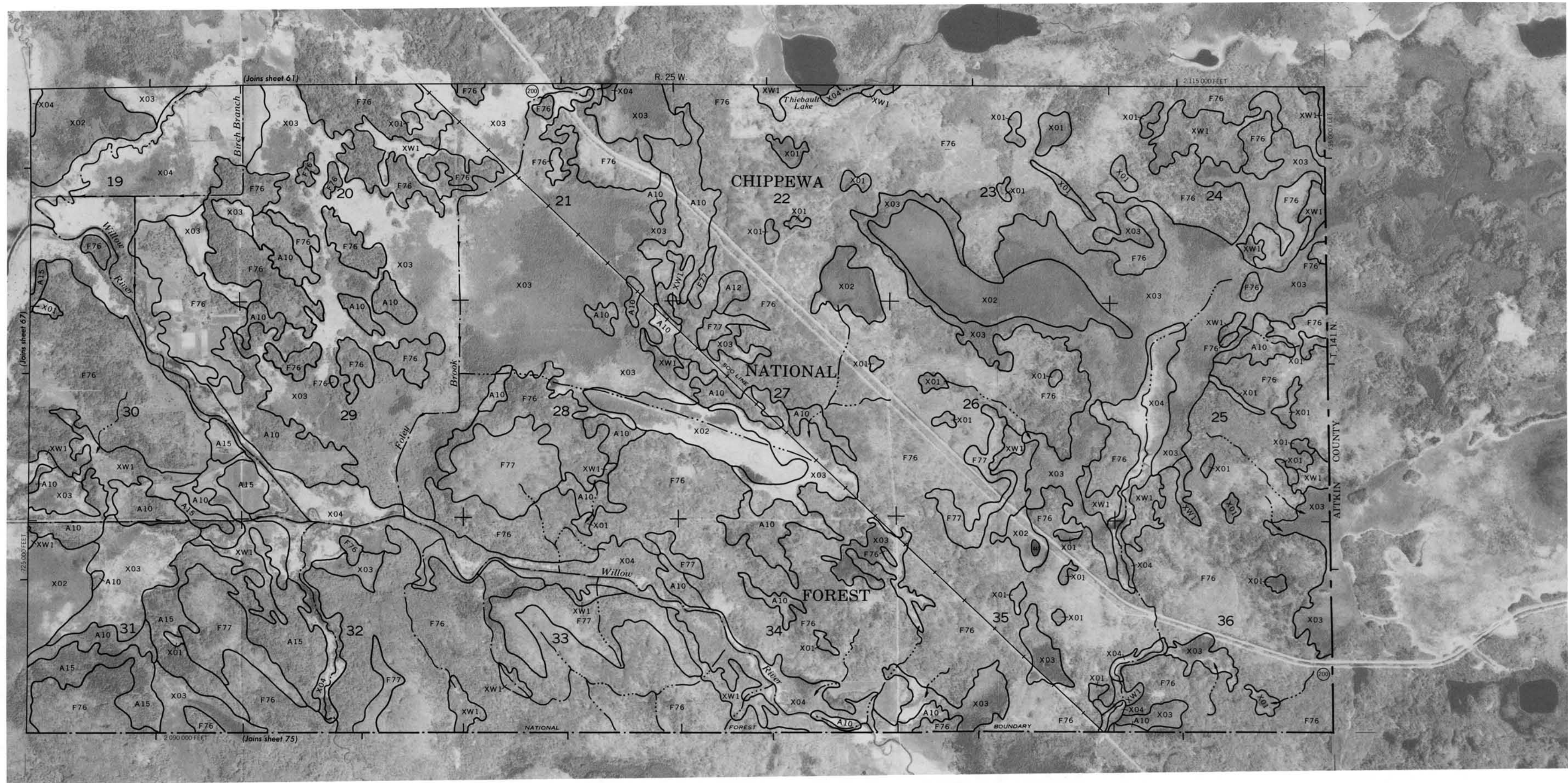


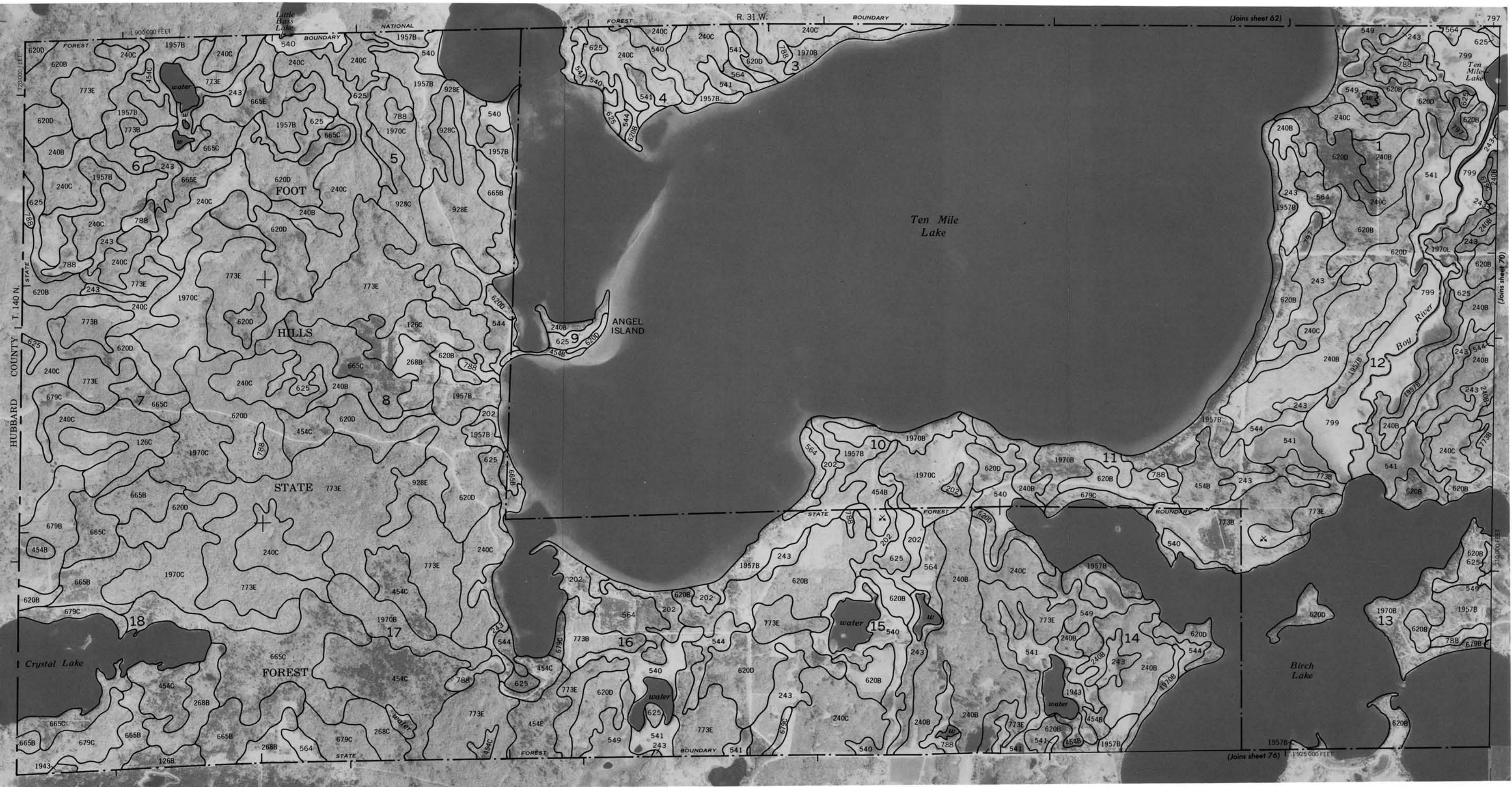


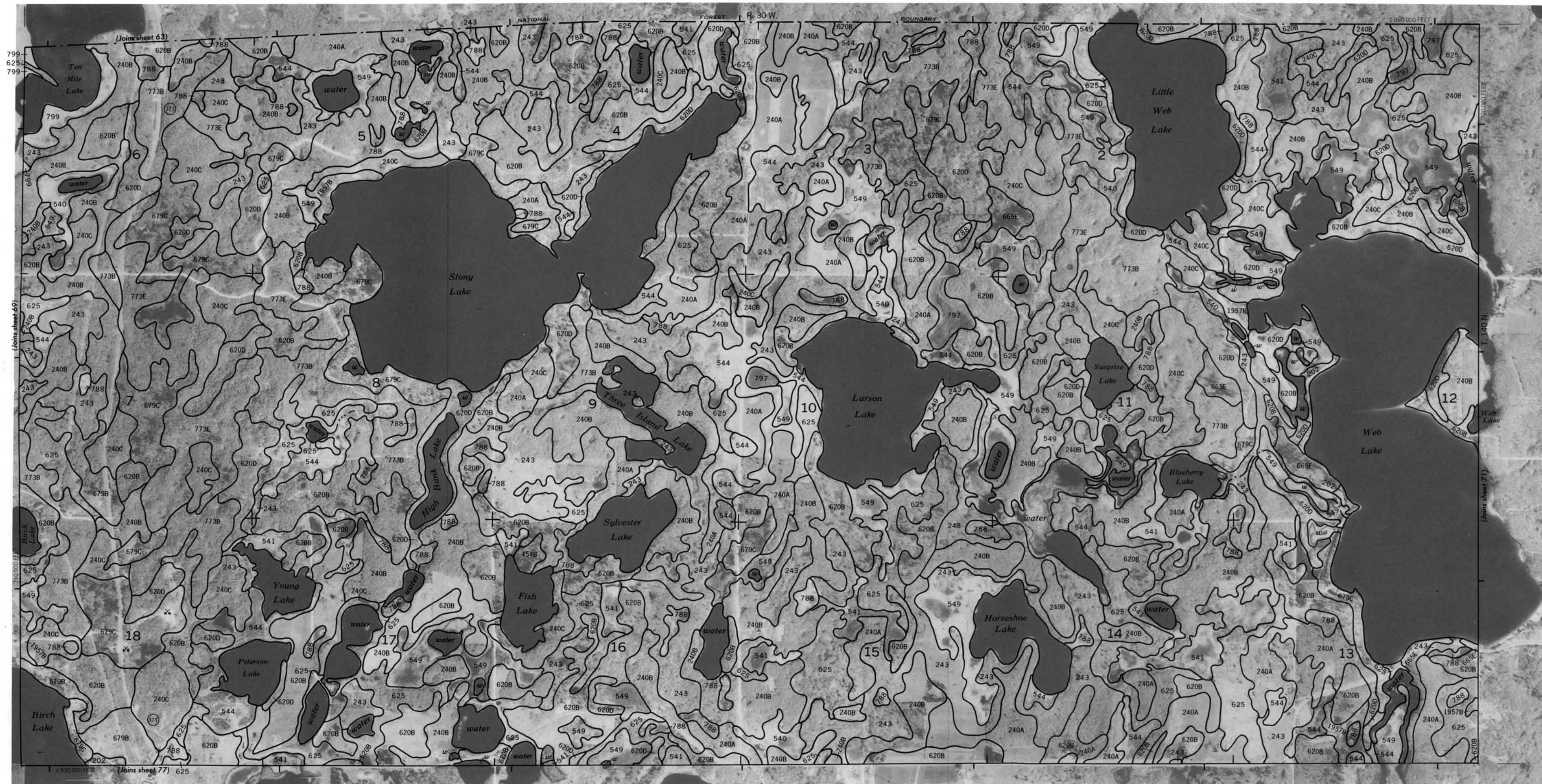


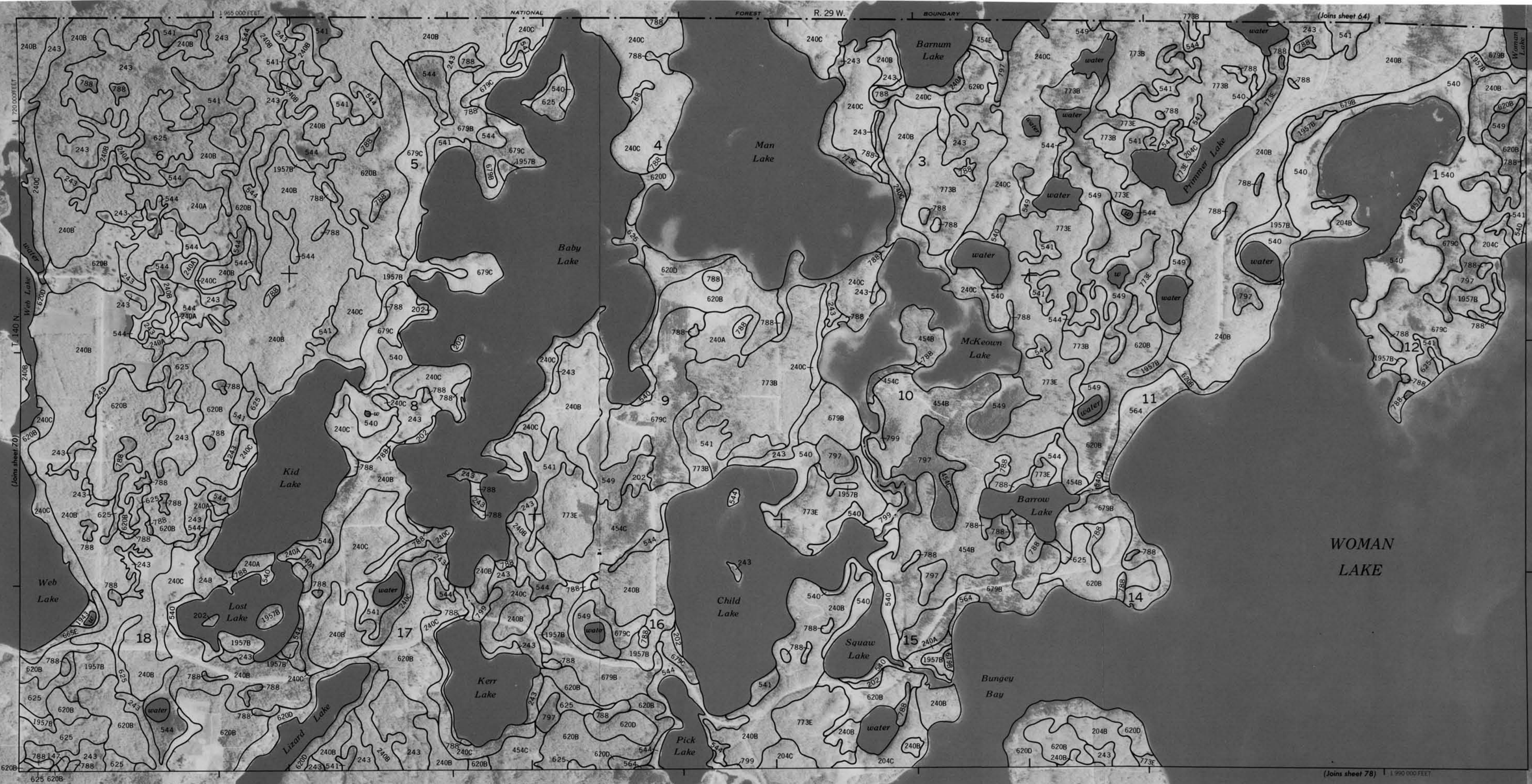


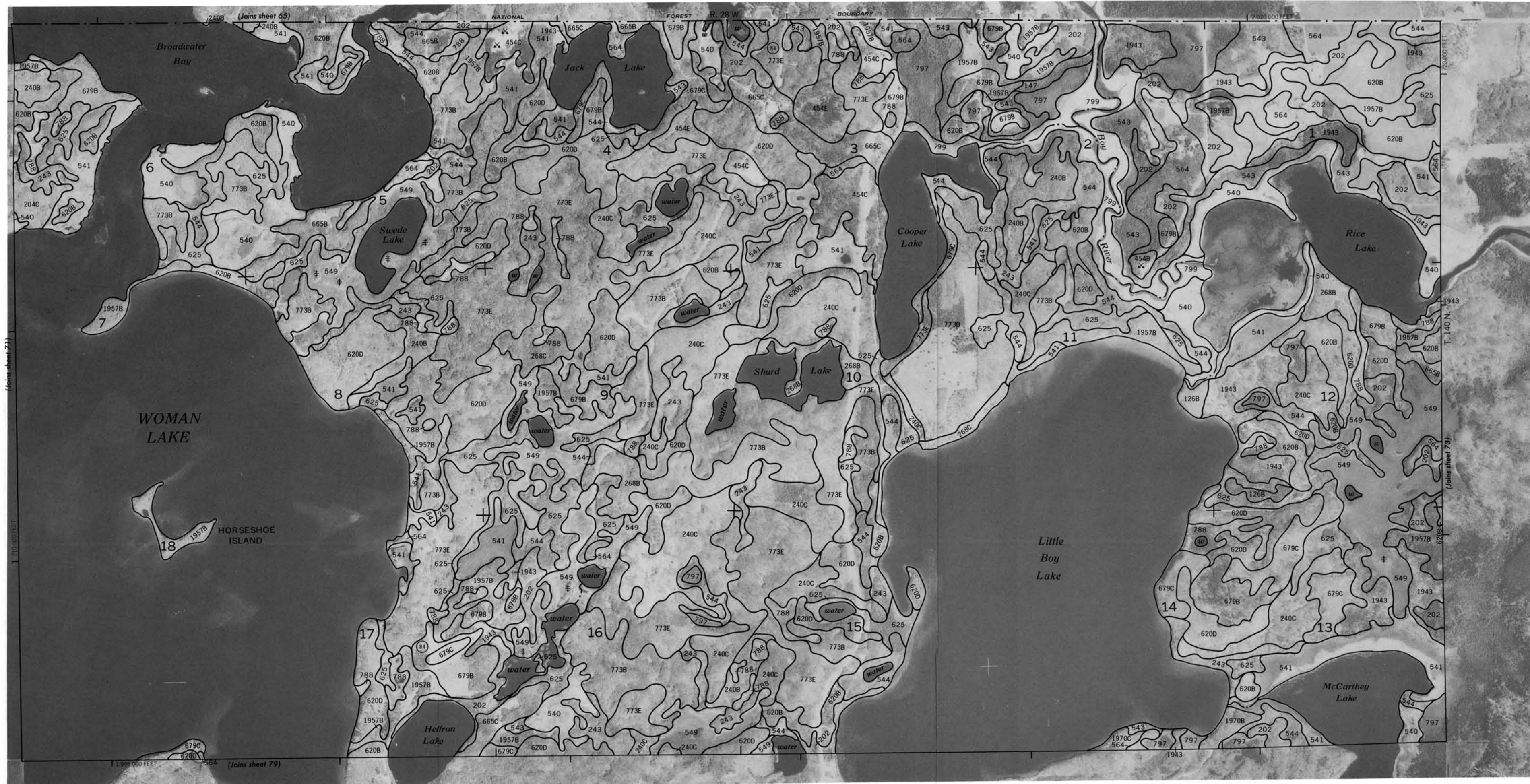








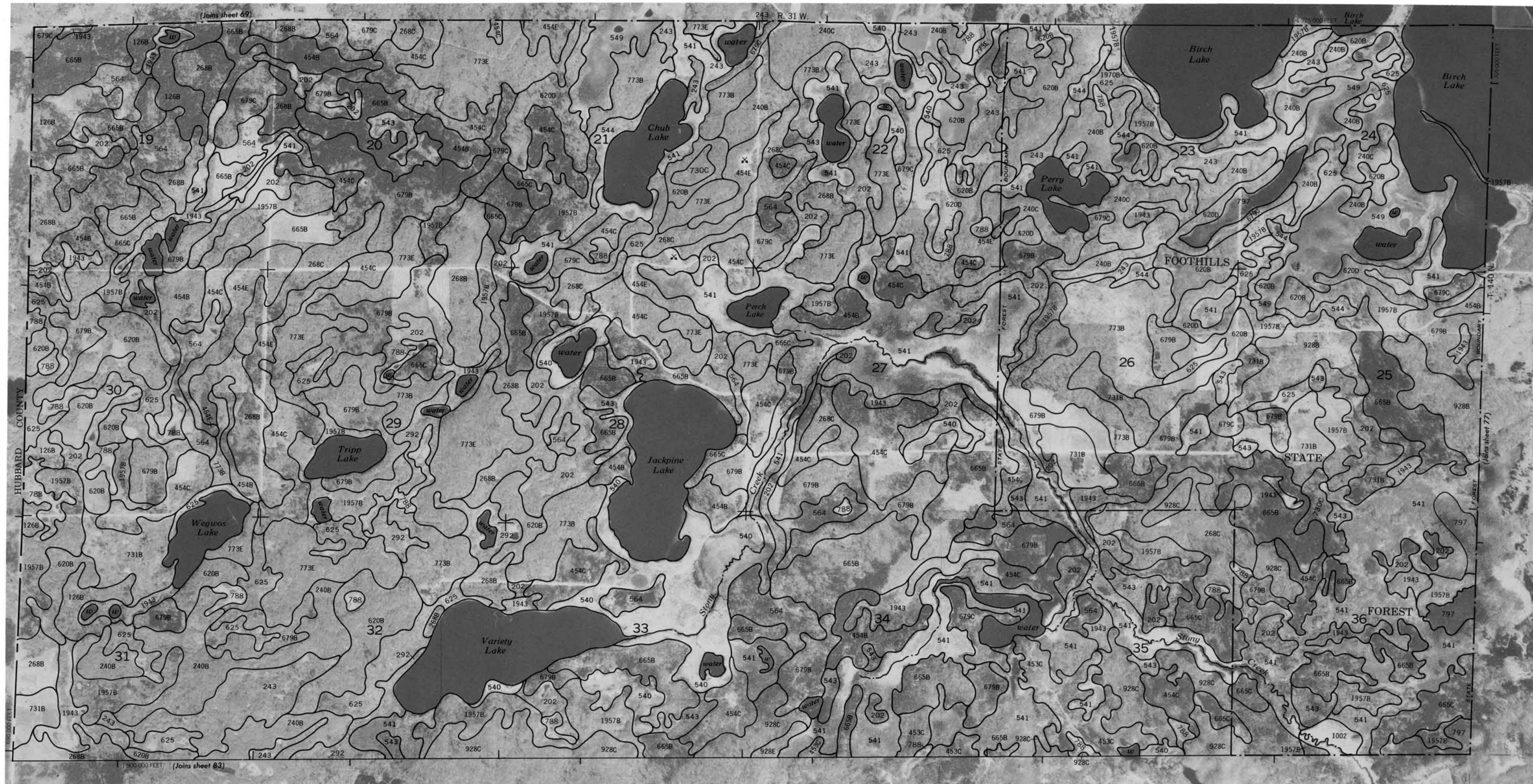


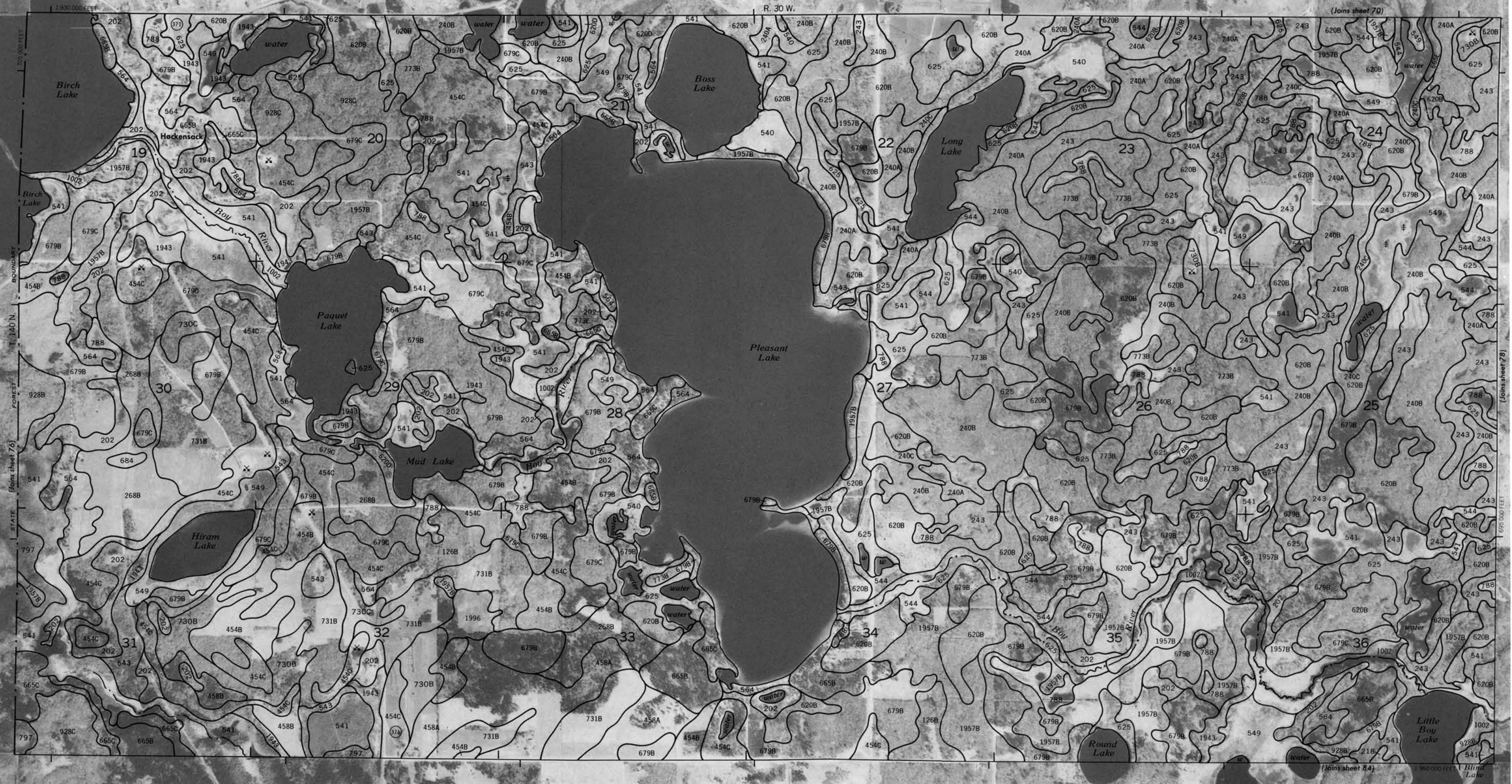














1 MILE

1 KILOMETER

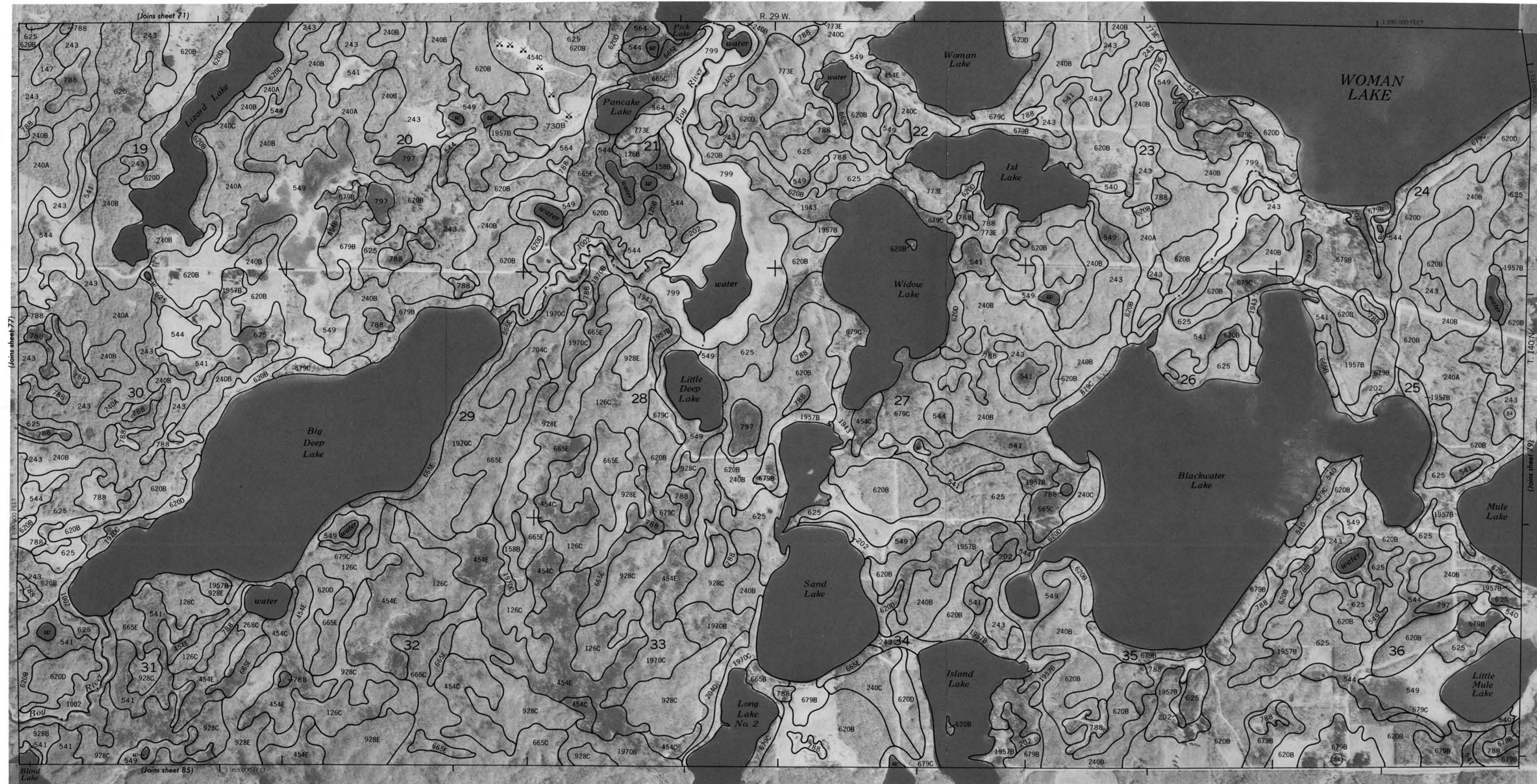
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1



(Joins sheet 77)

(Joins sheet 71)

R. 29 W.

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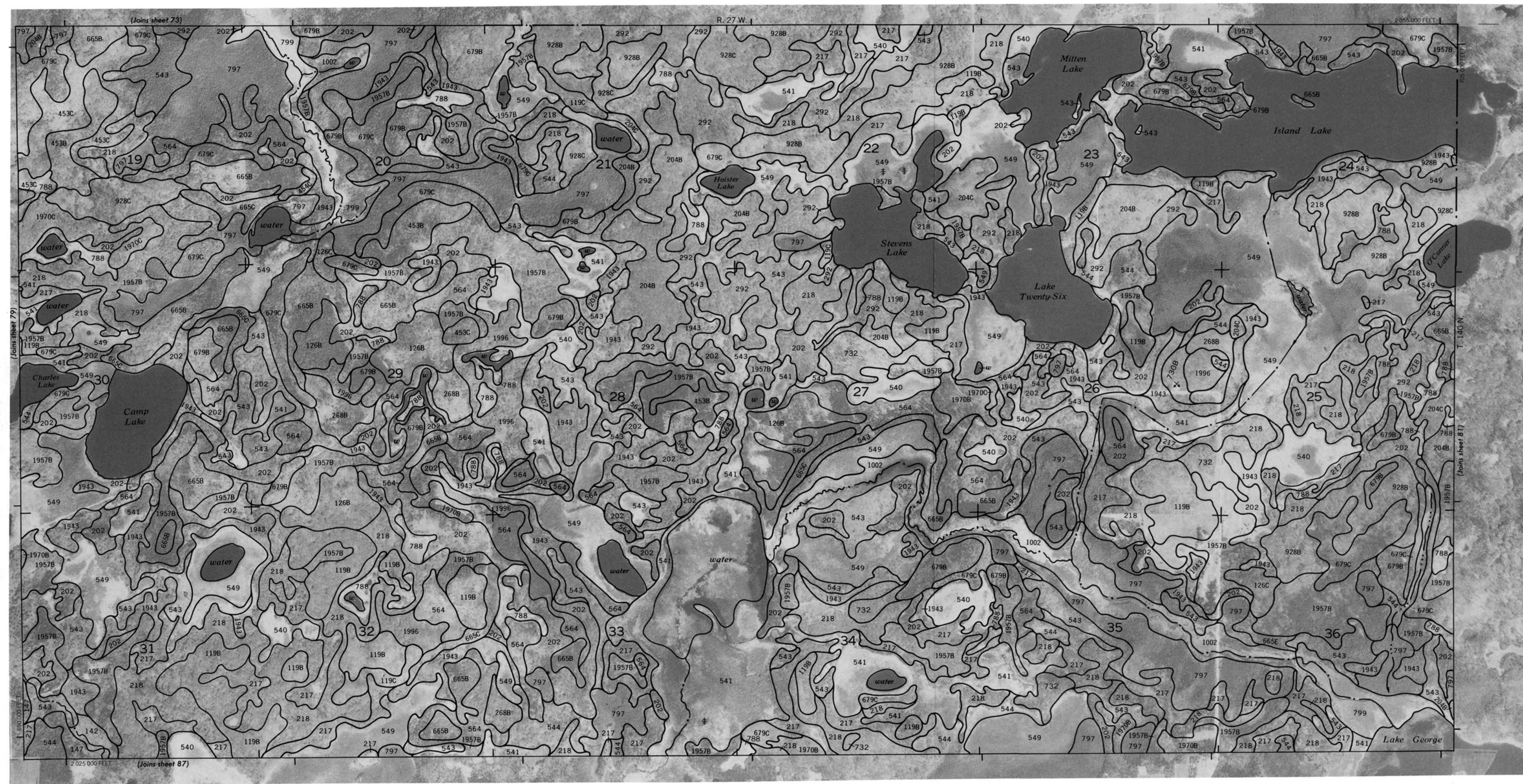
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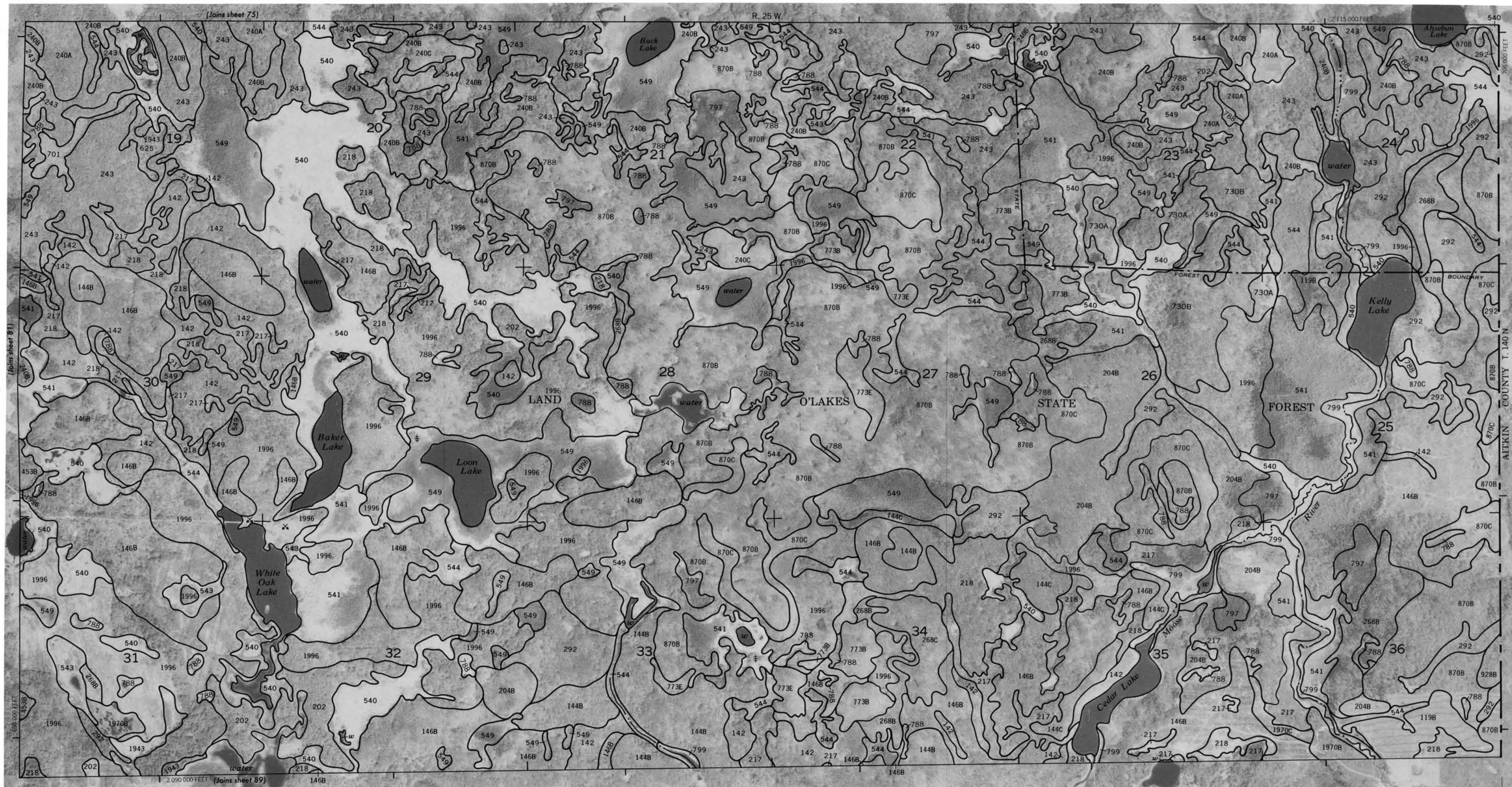
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T. 140 N.



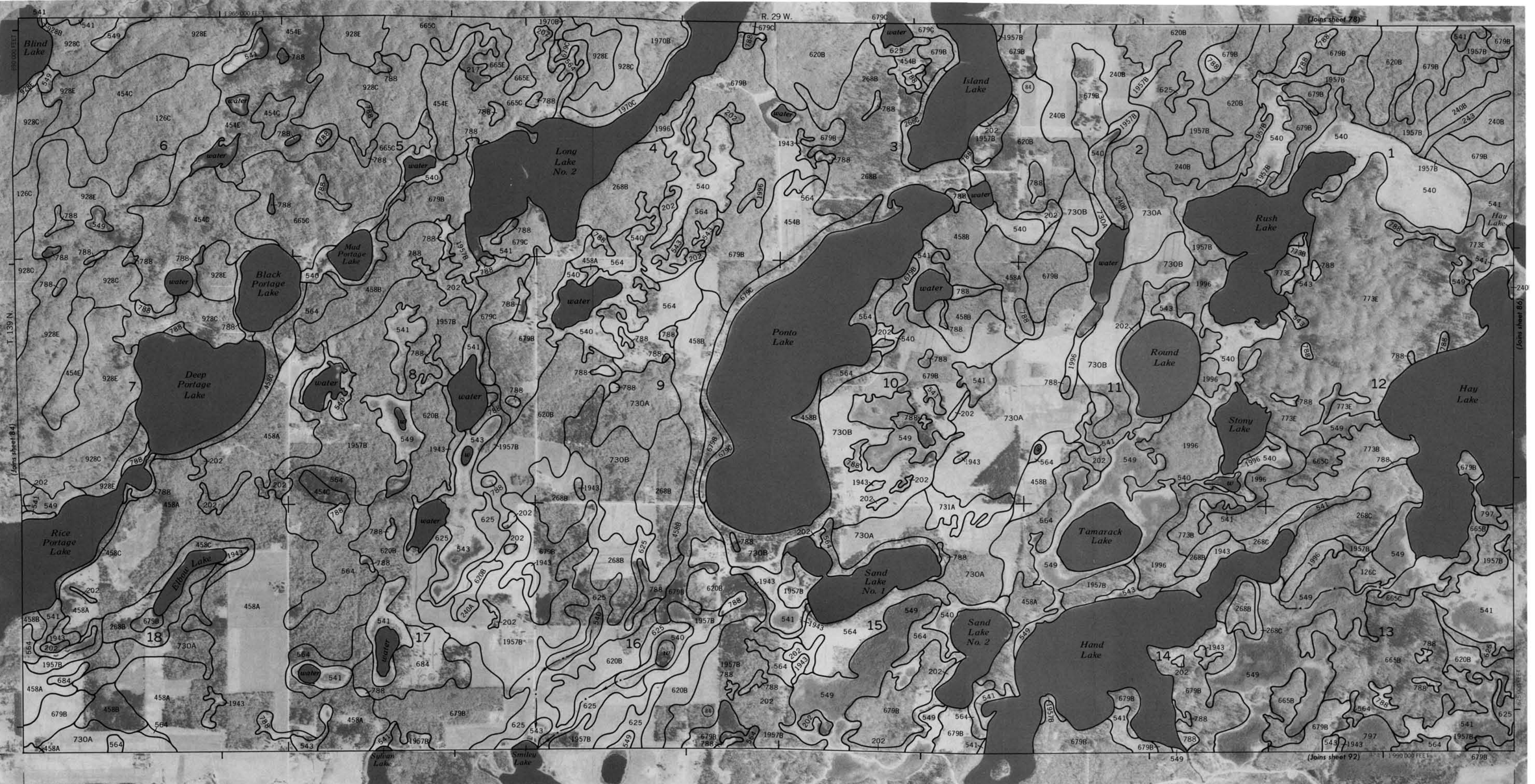


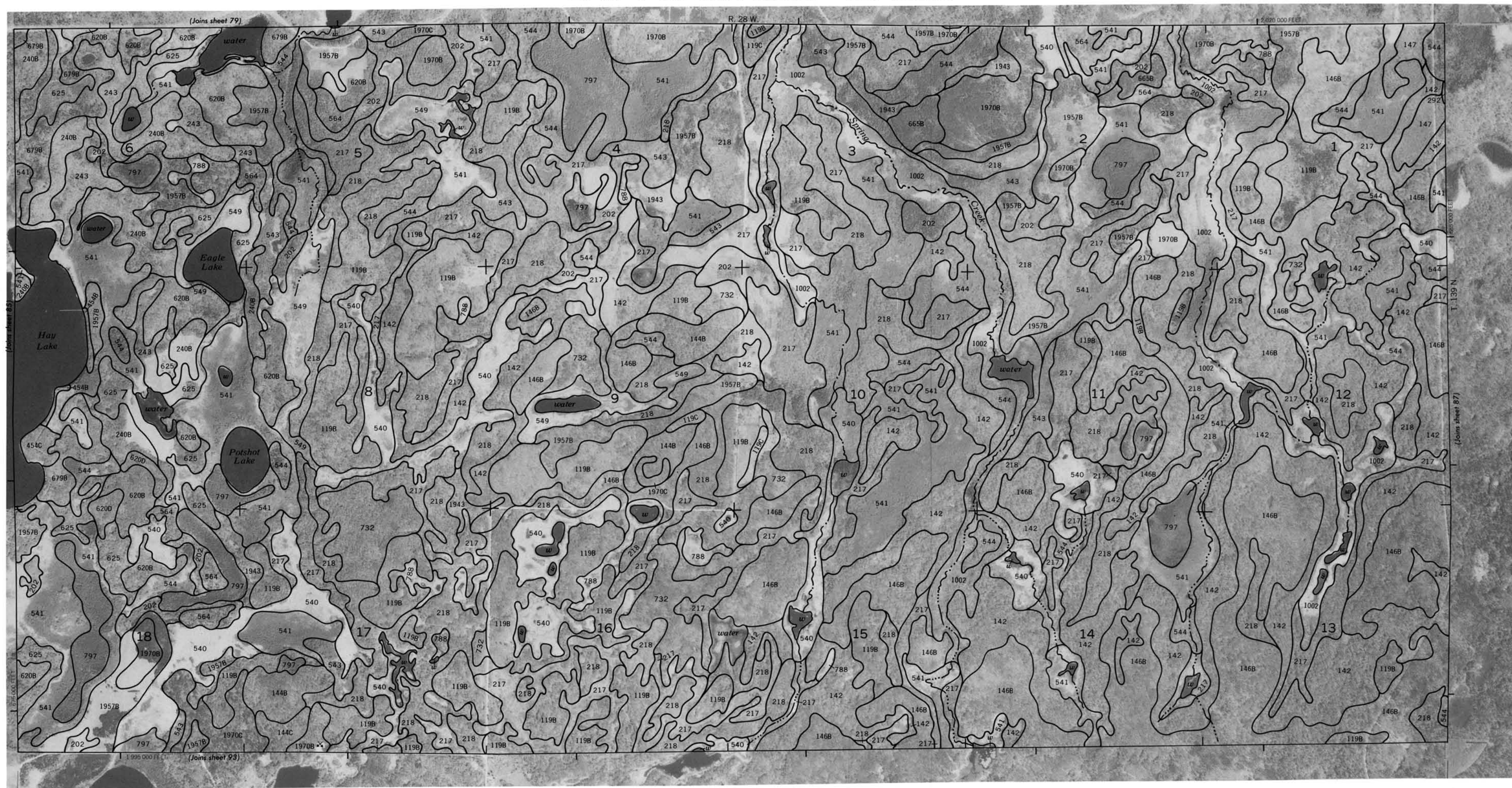




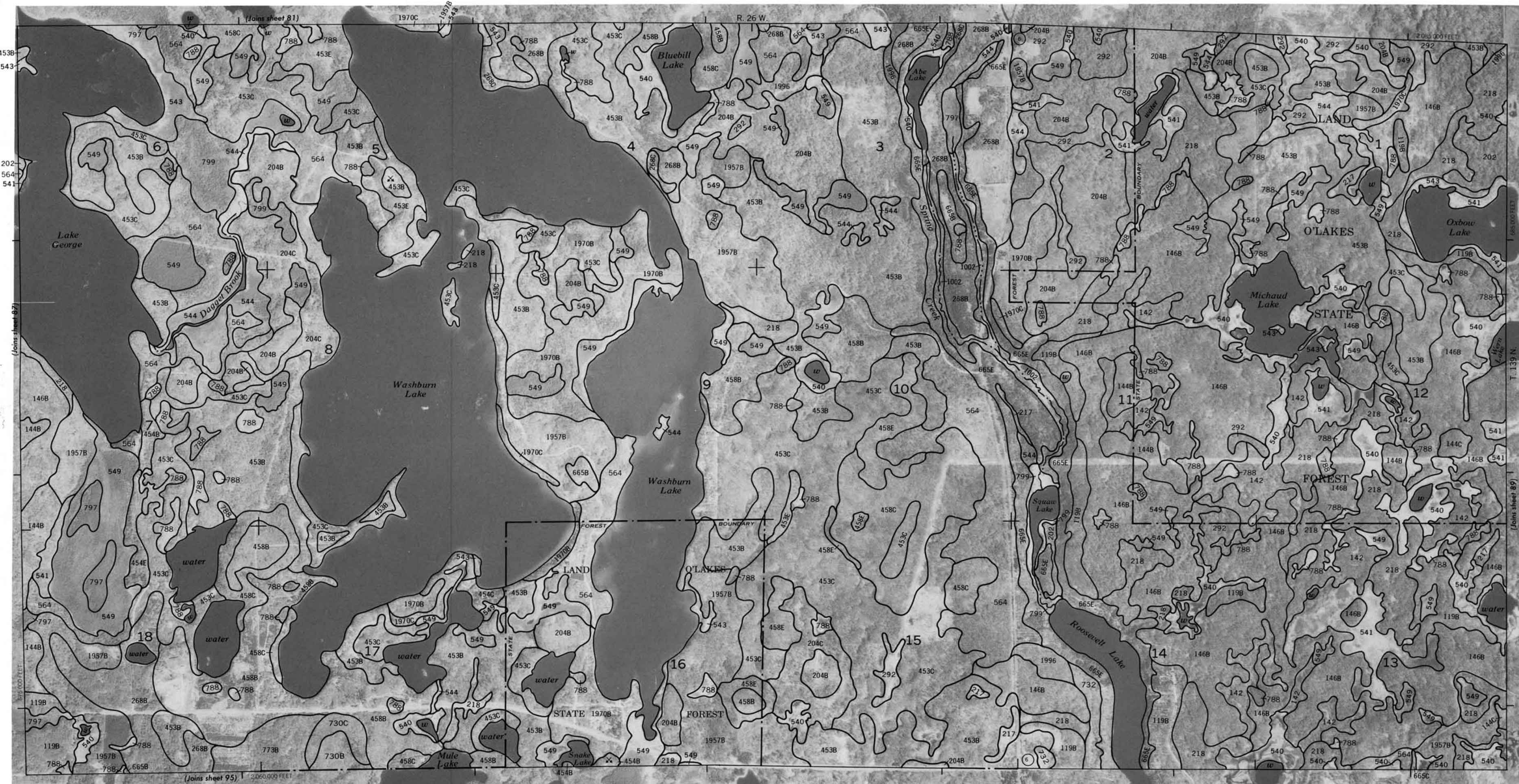


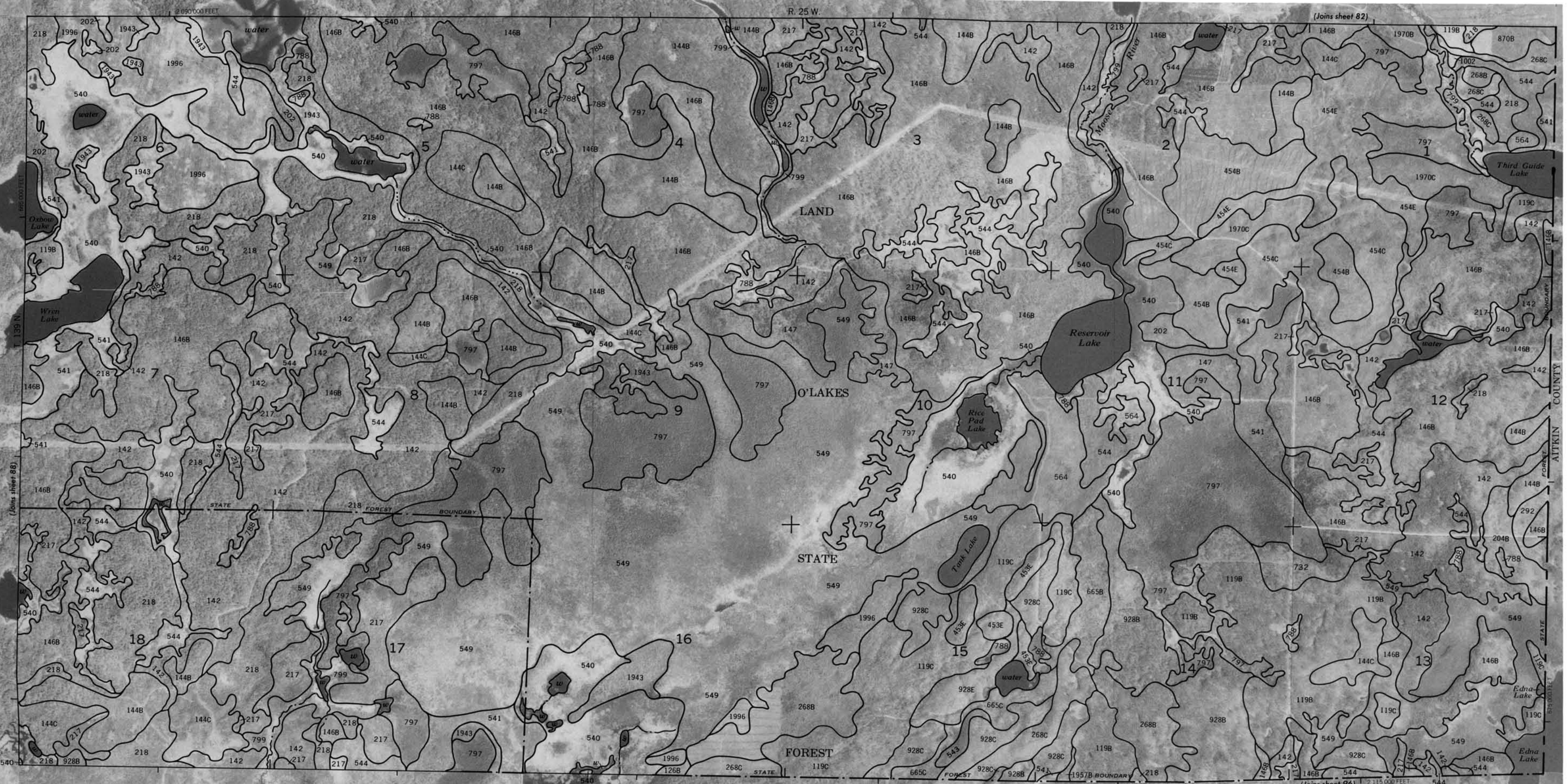


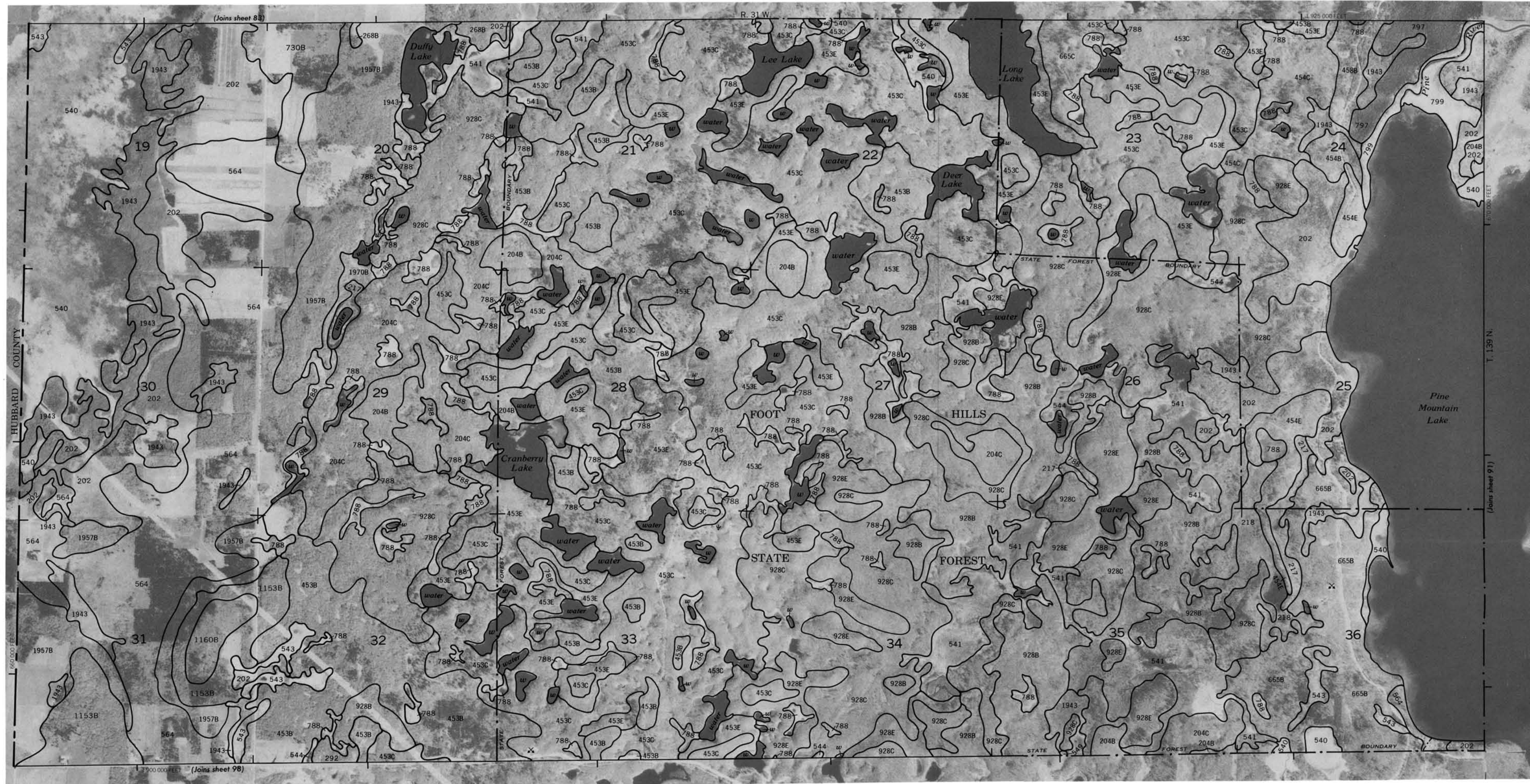


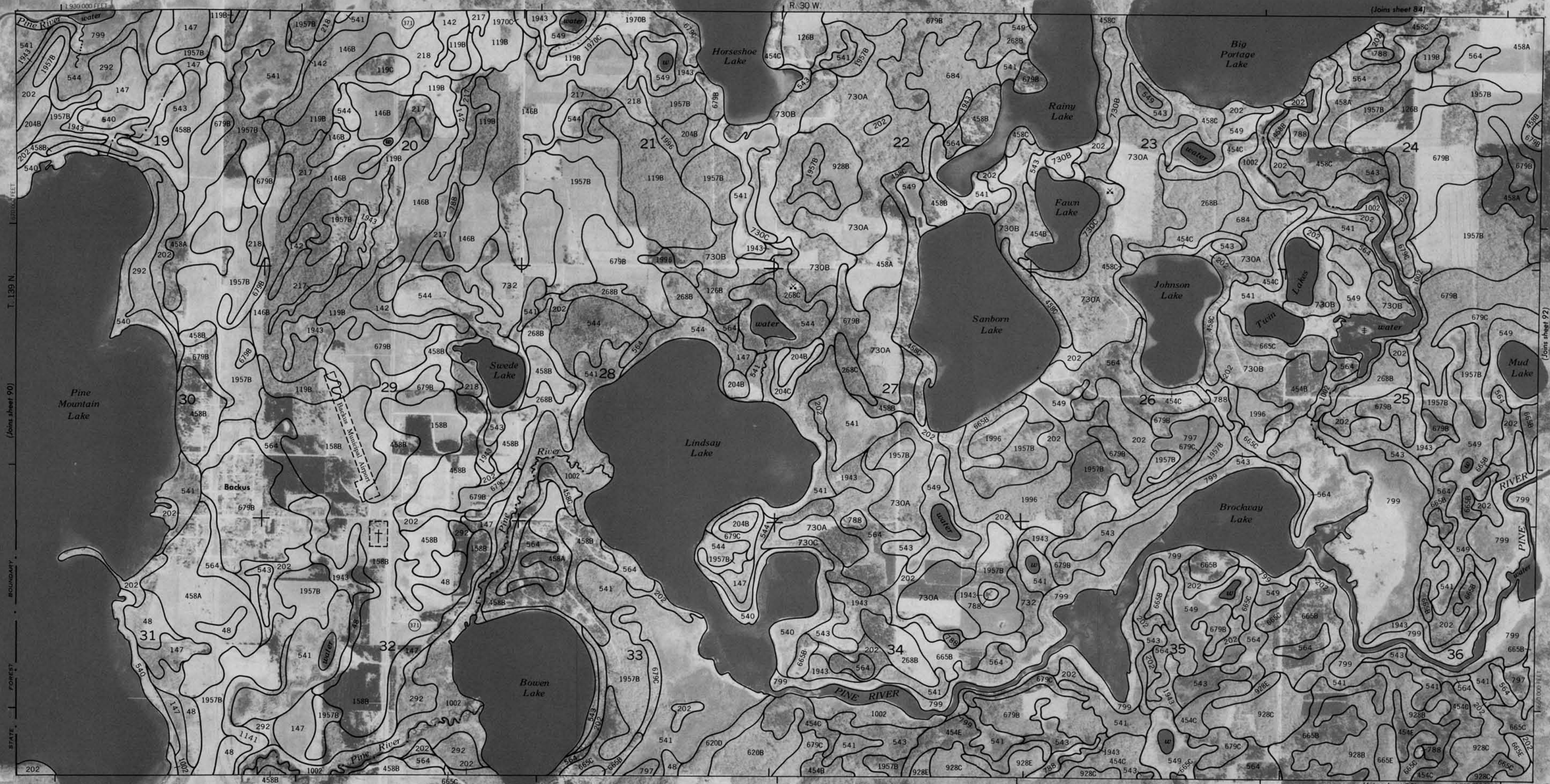






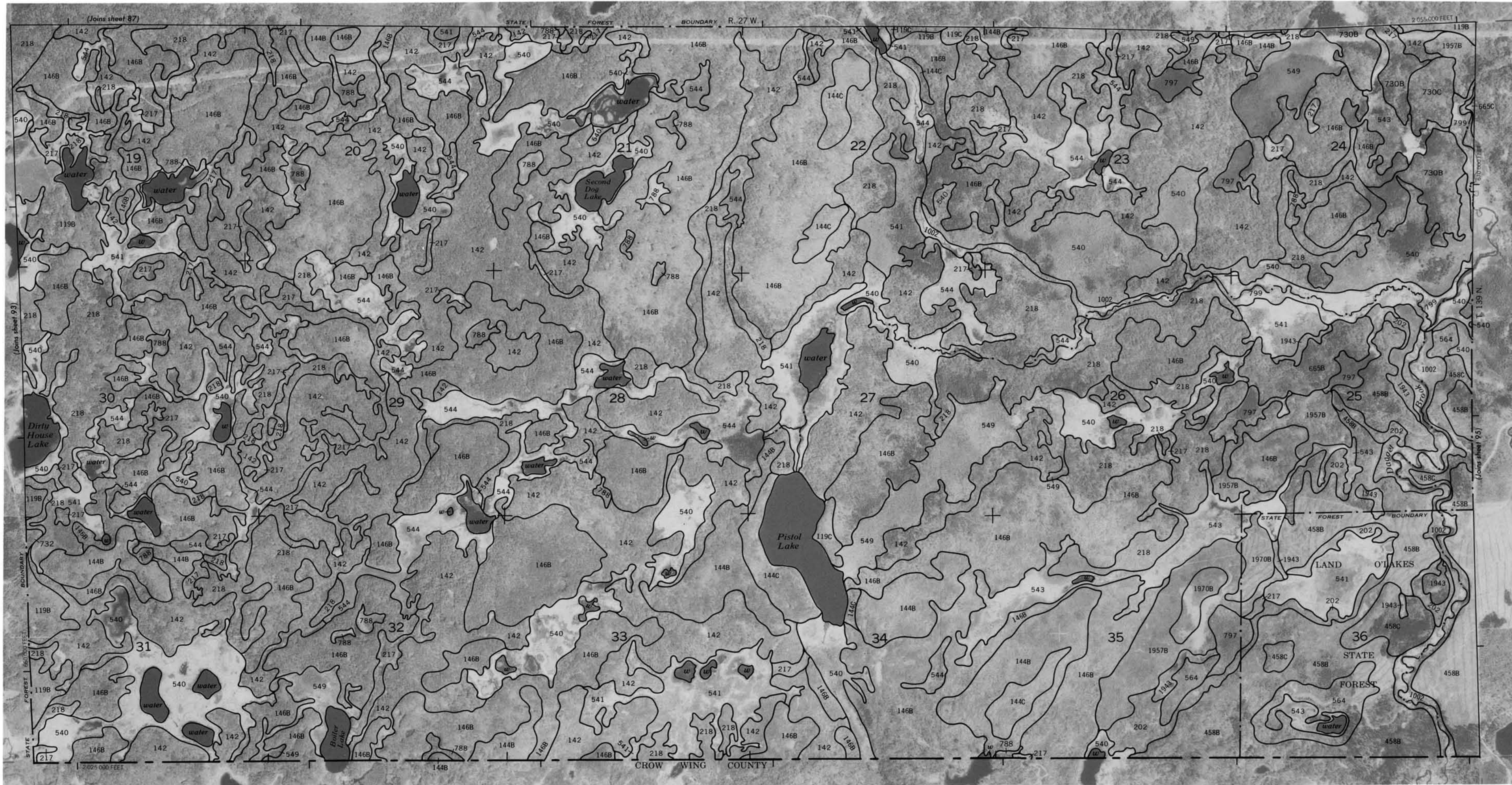














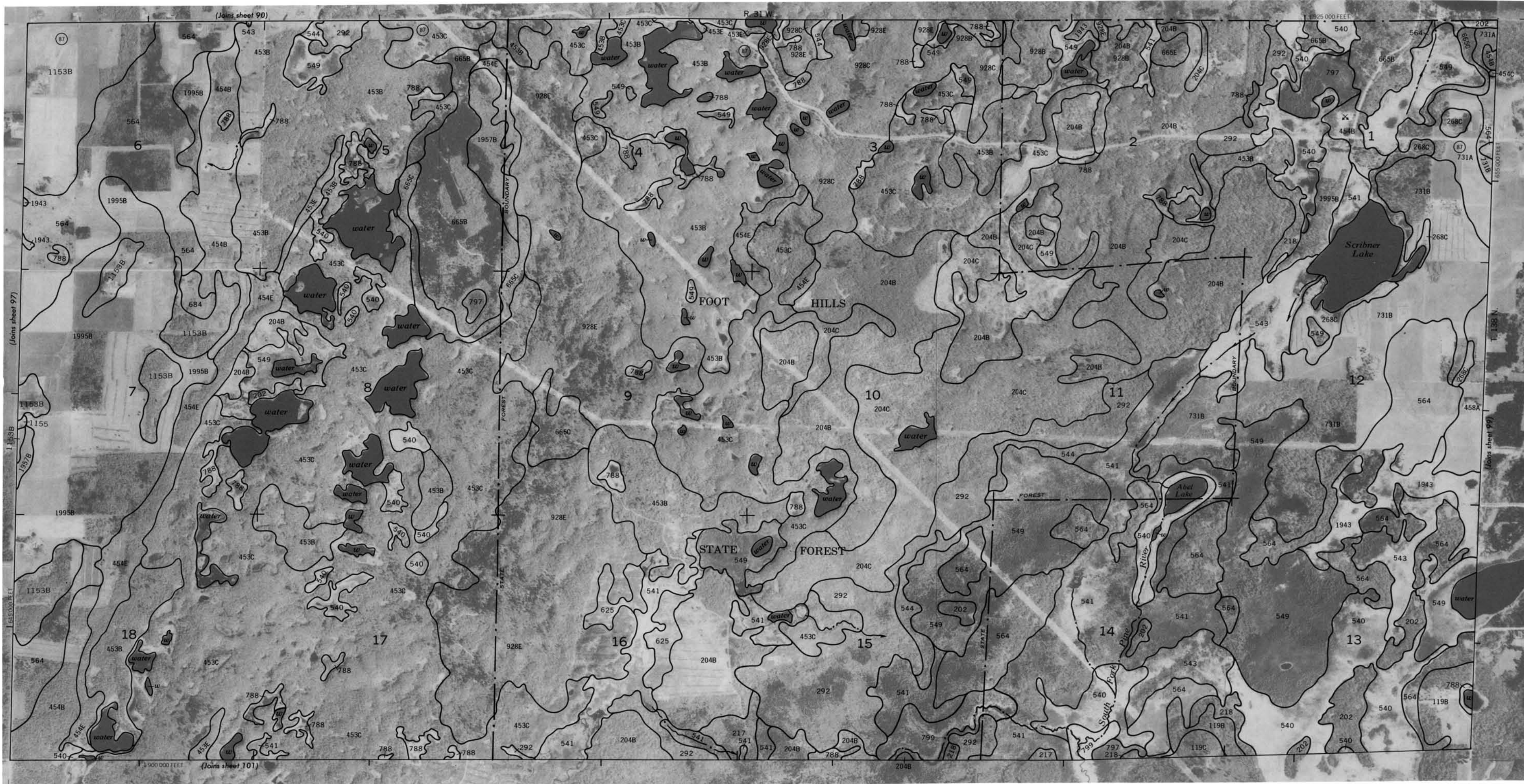


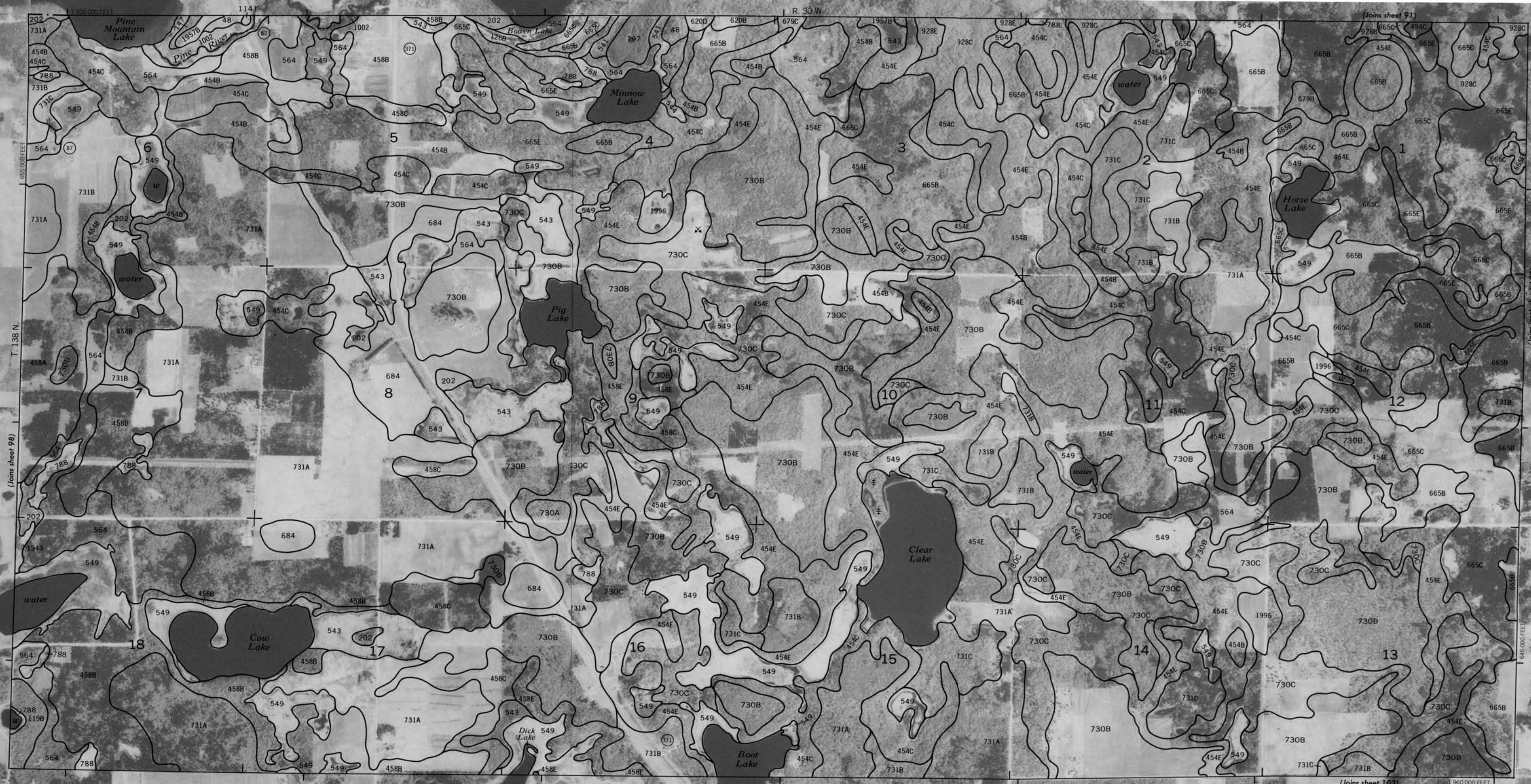


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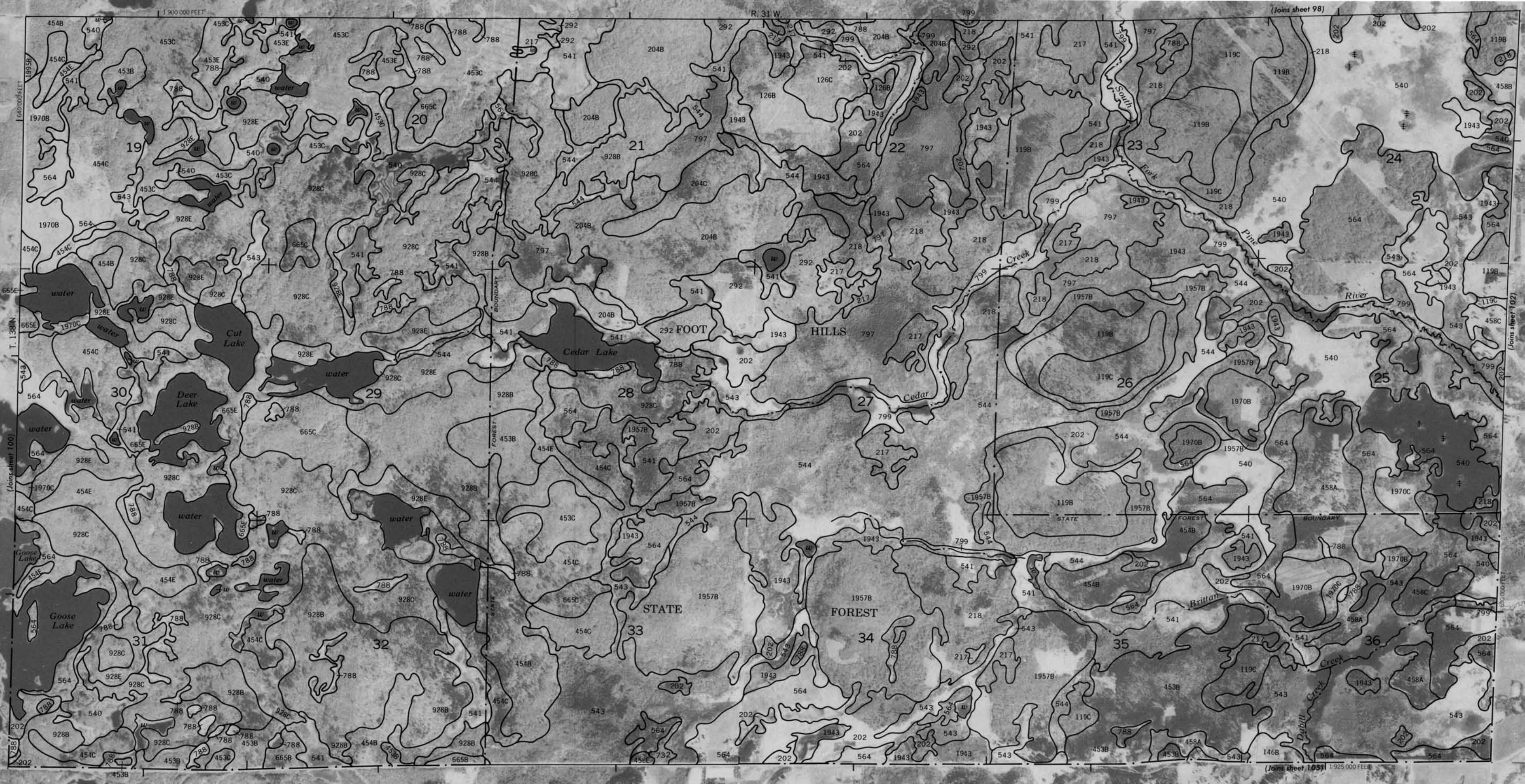
R. 32 W. HUBBARD COUNTY

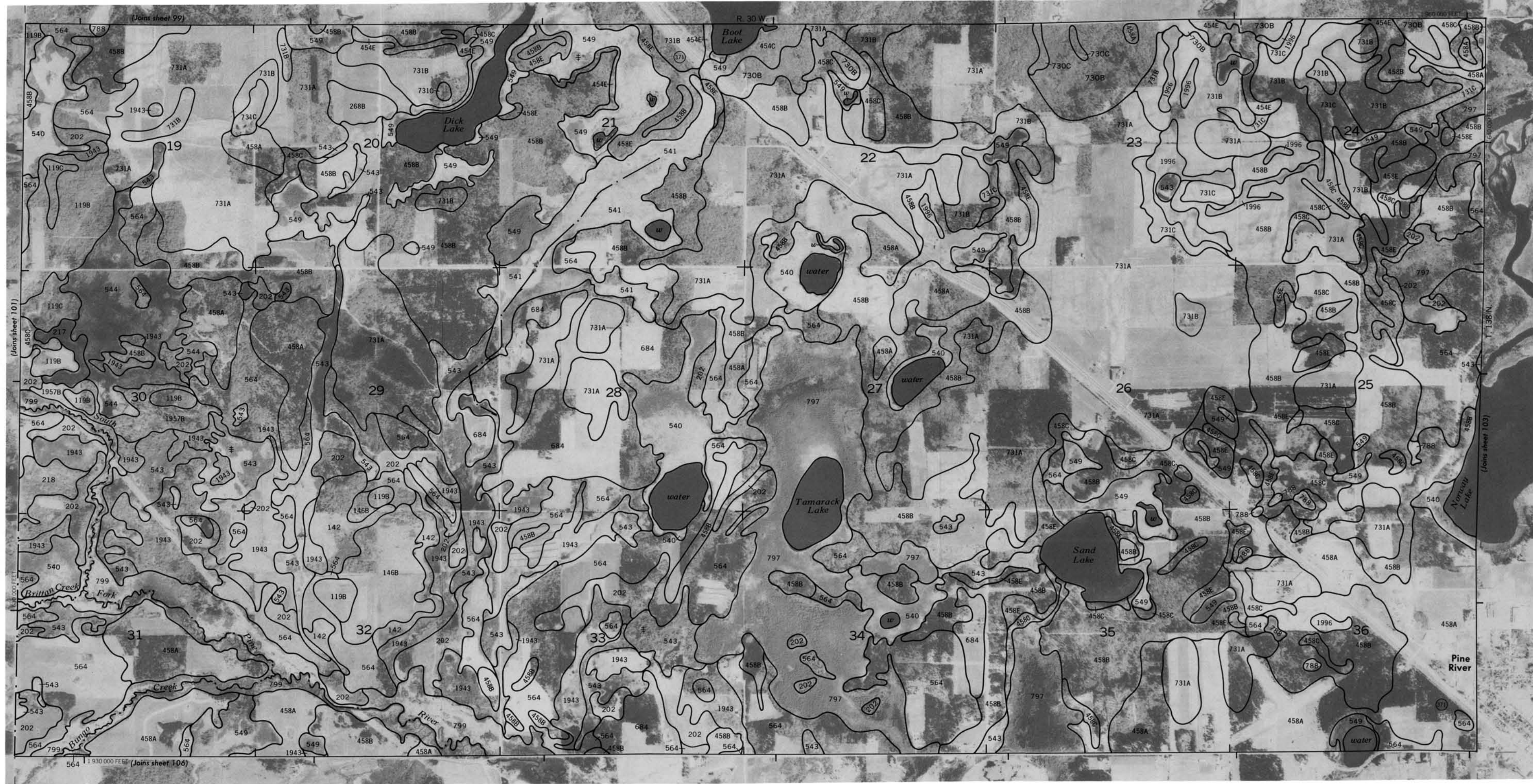
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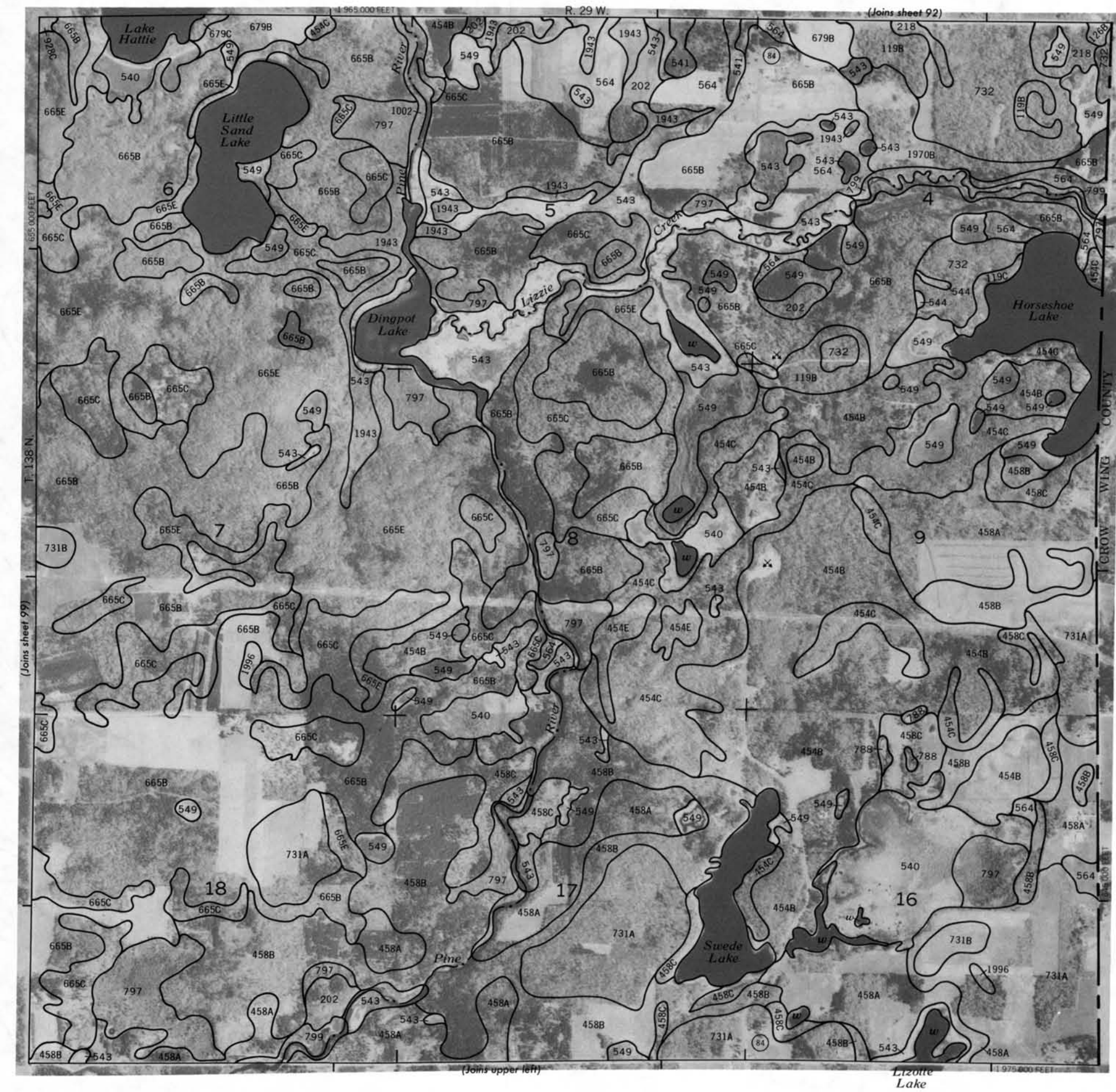


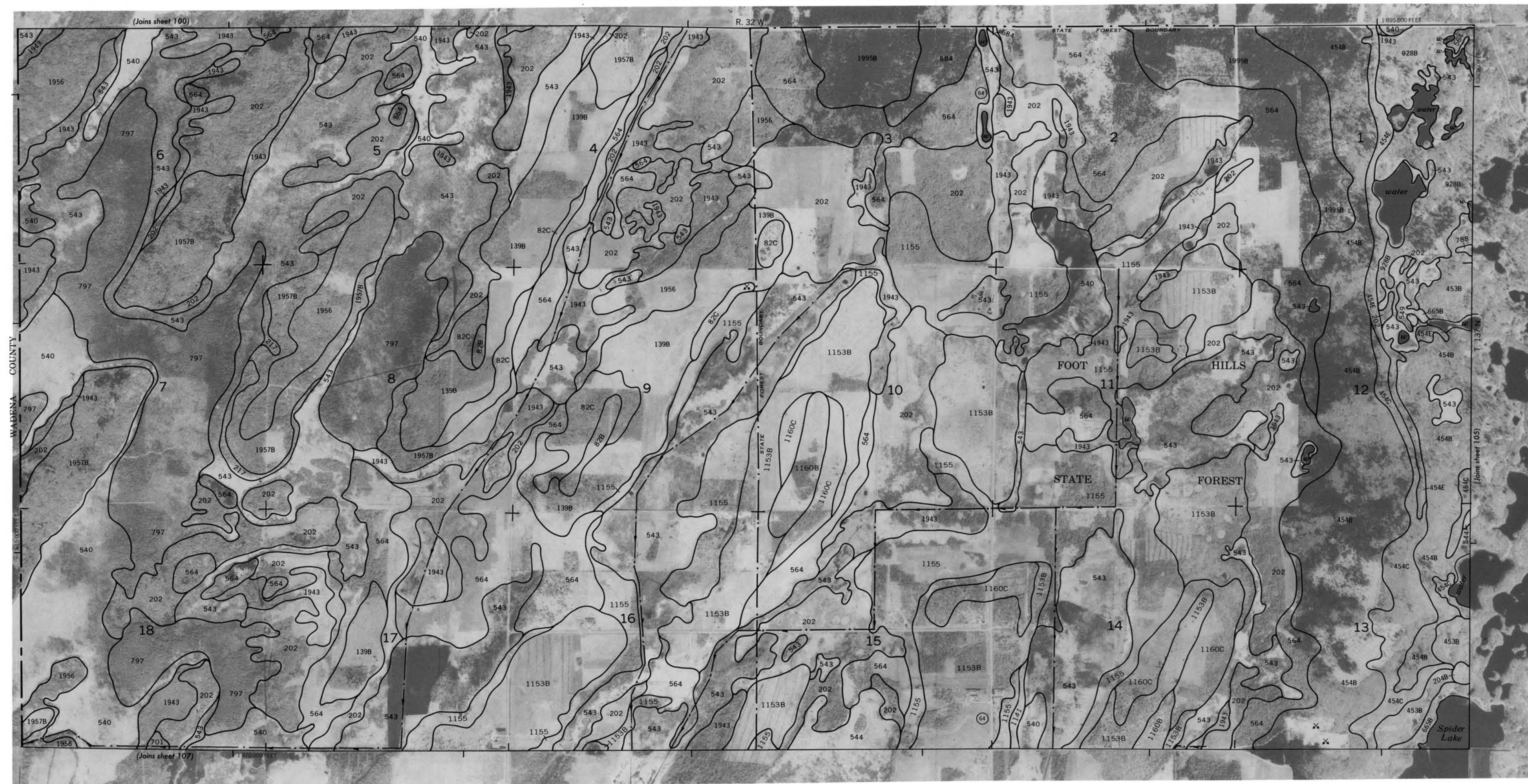






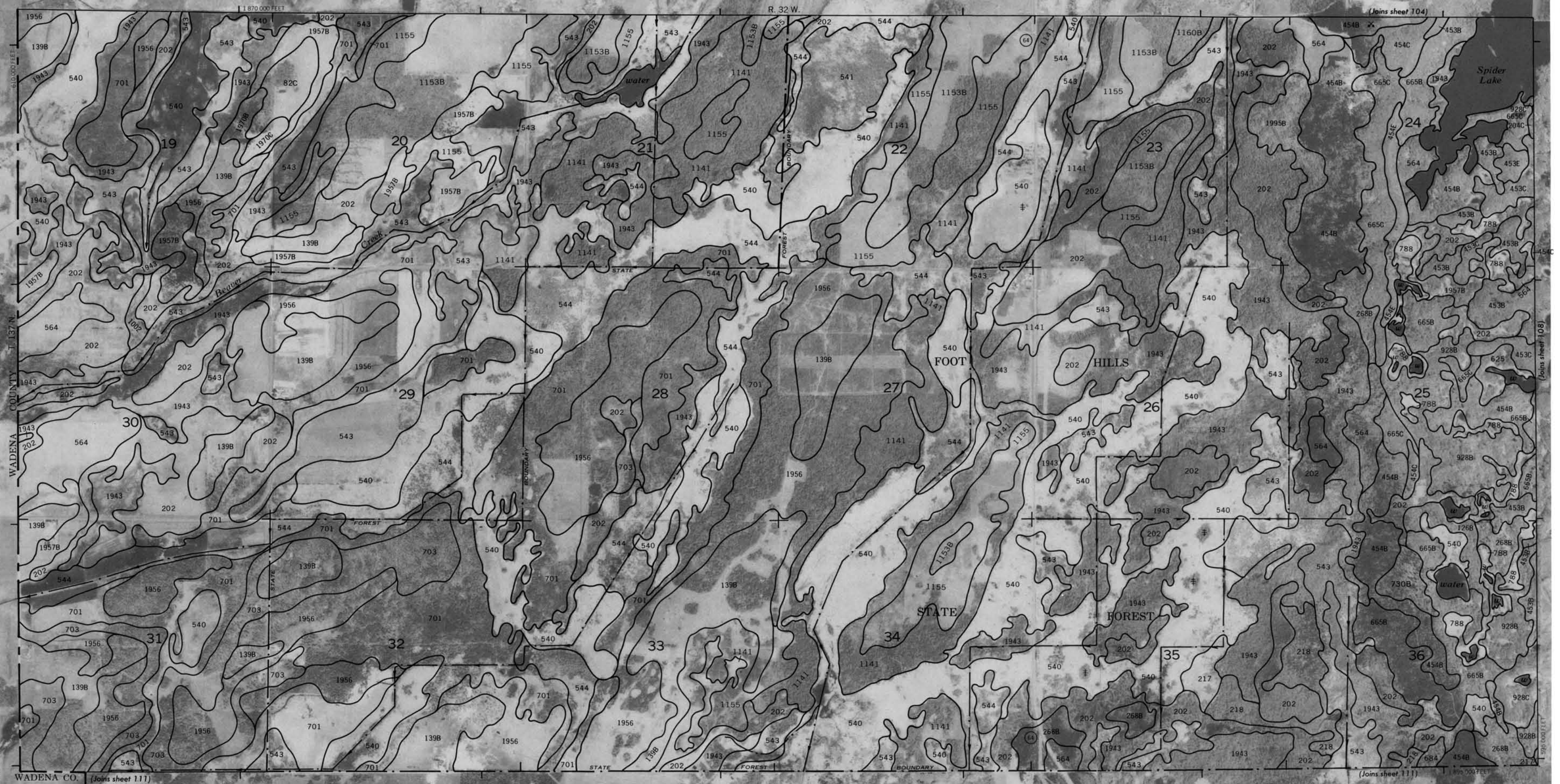


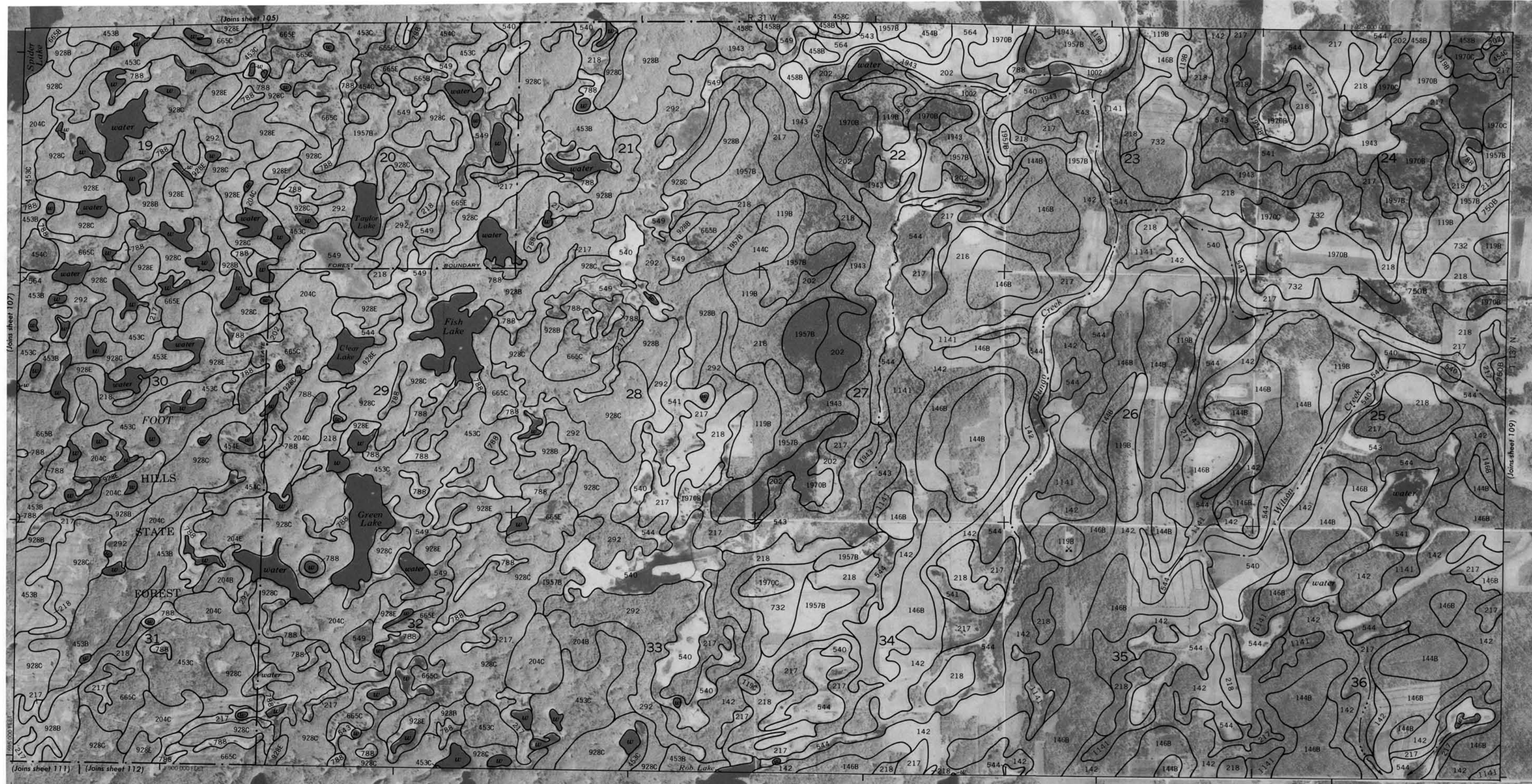










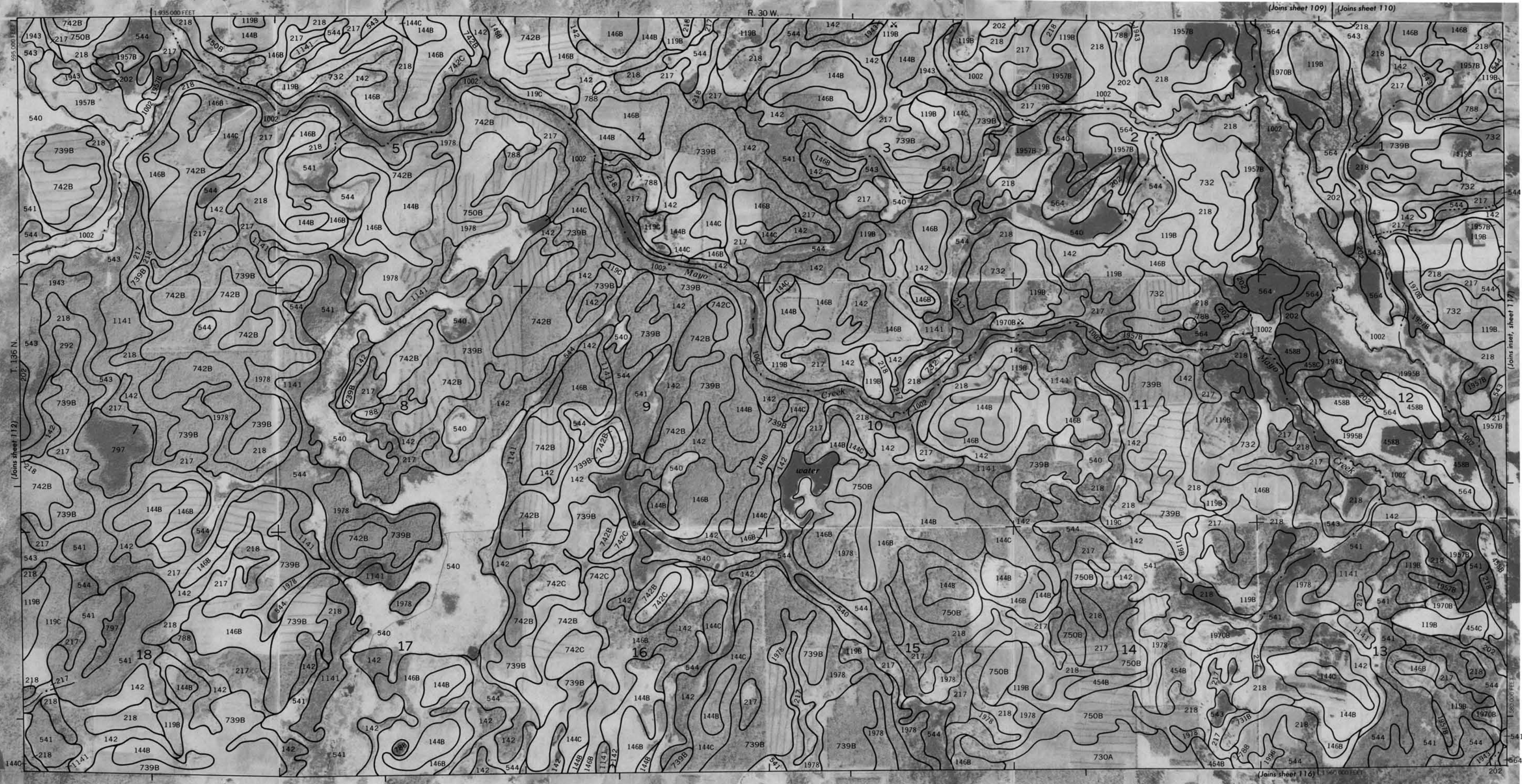




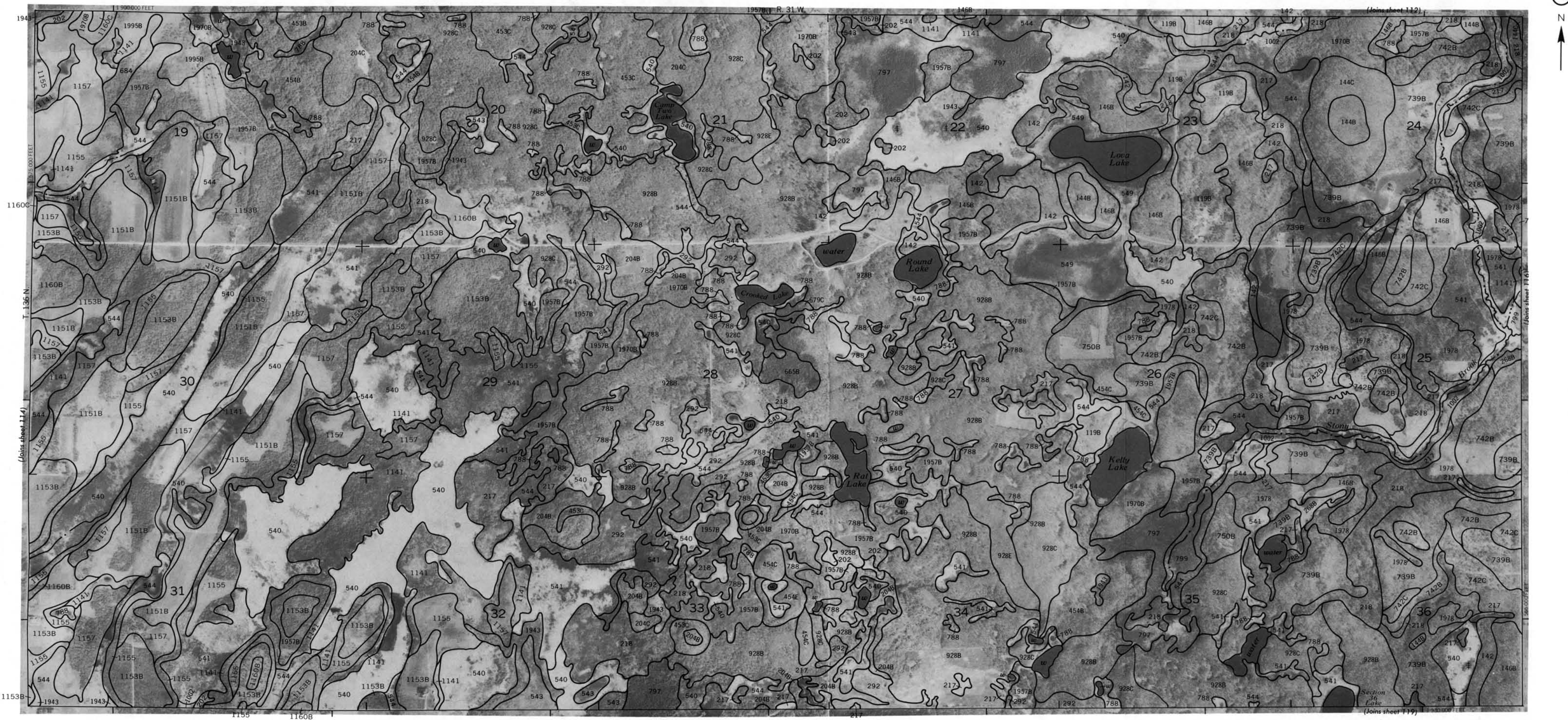


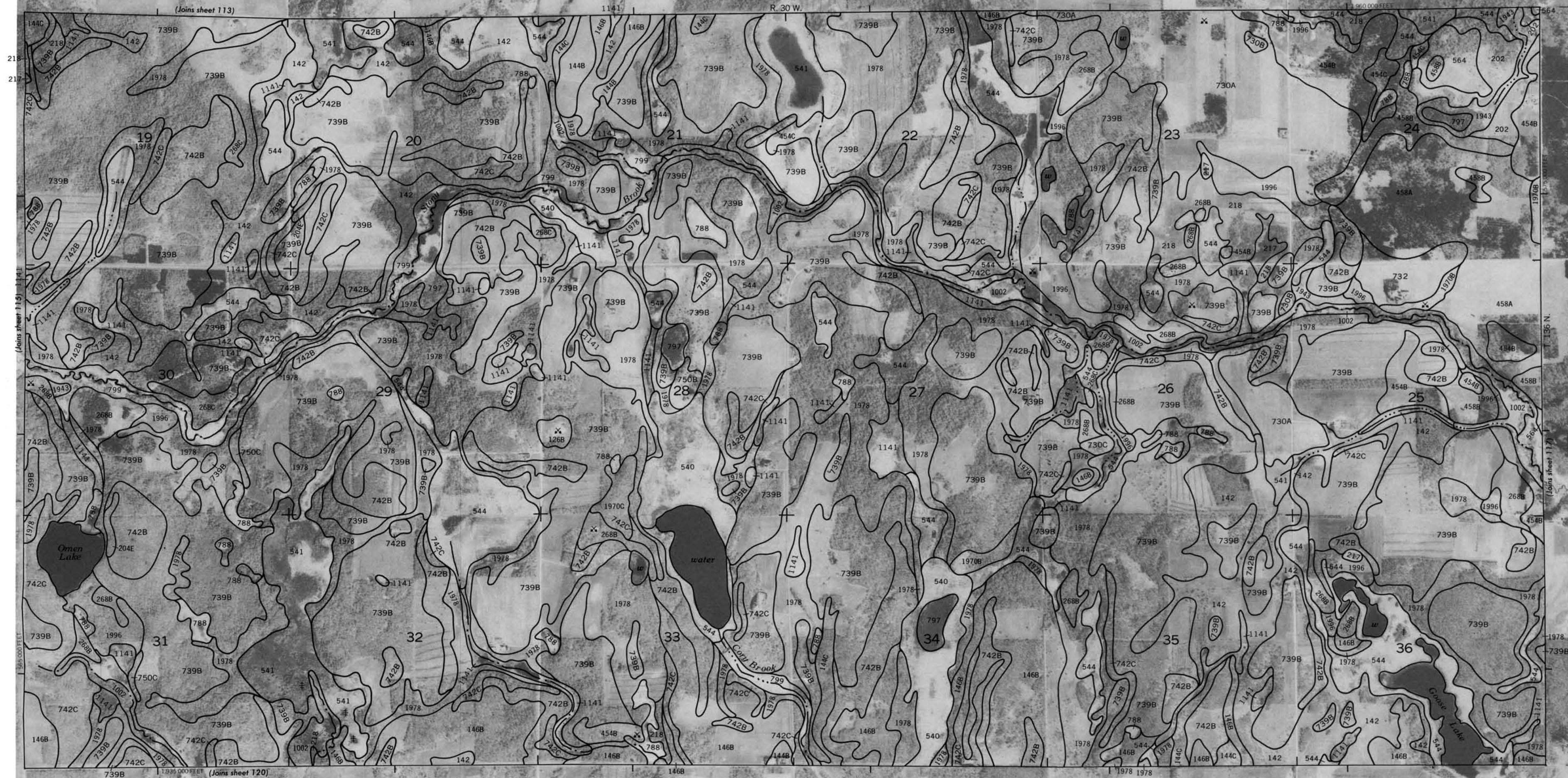




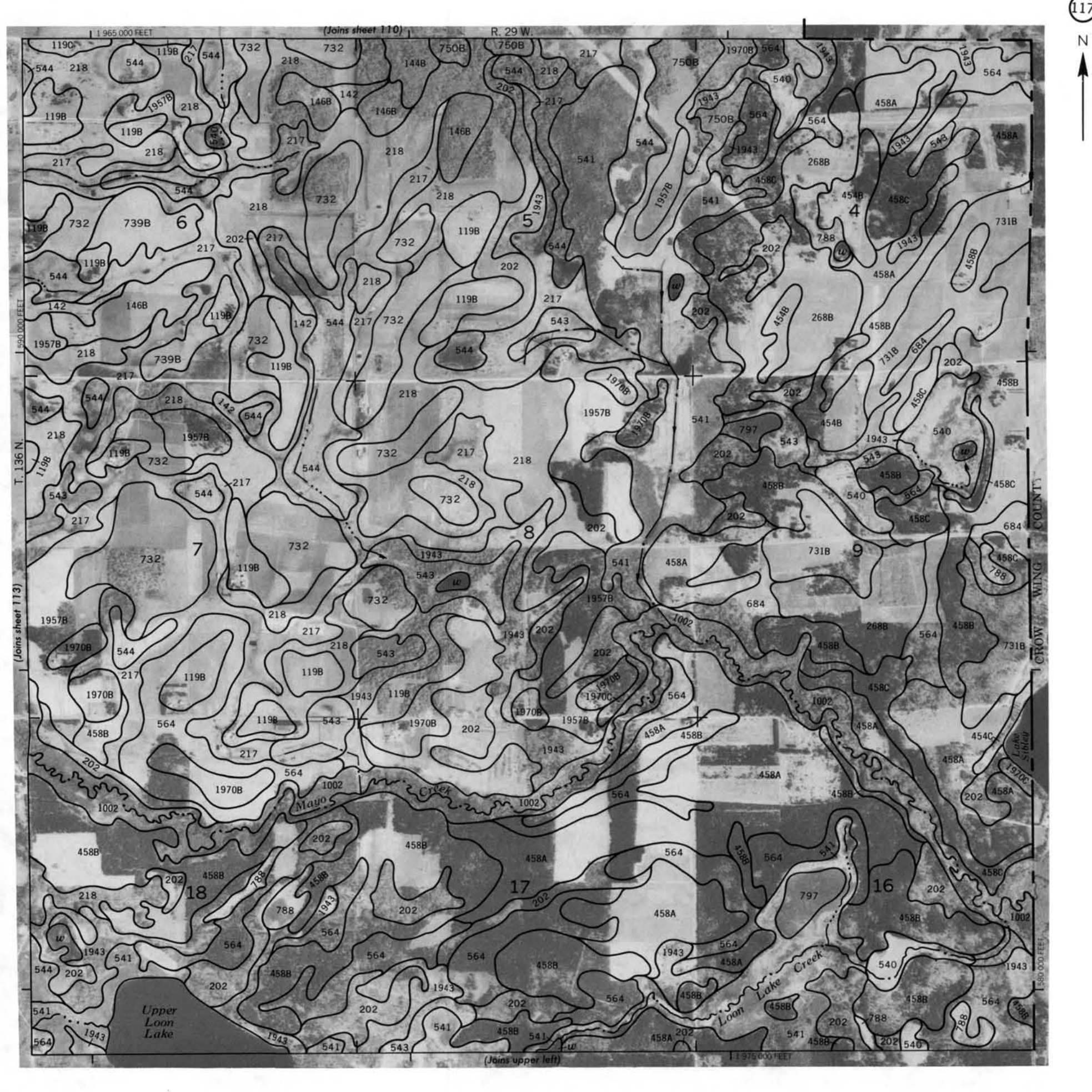
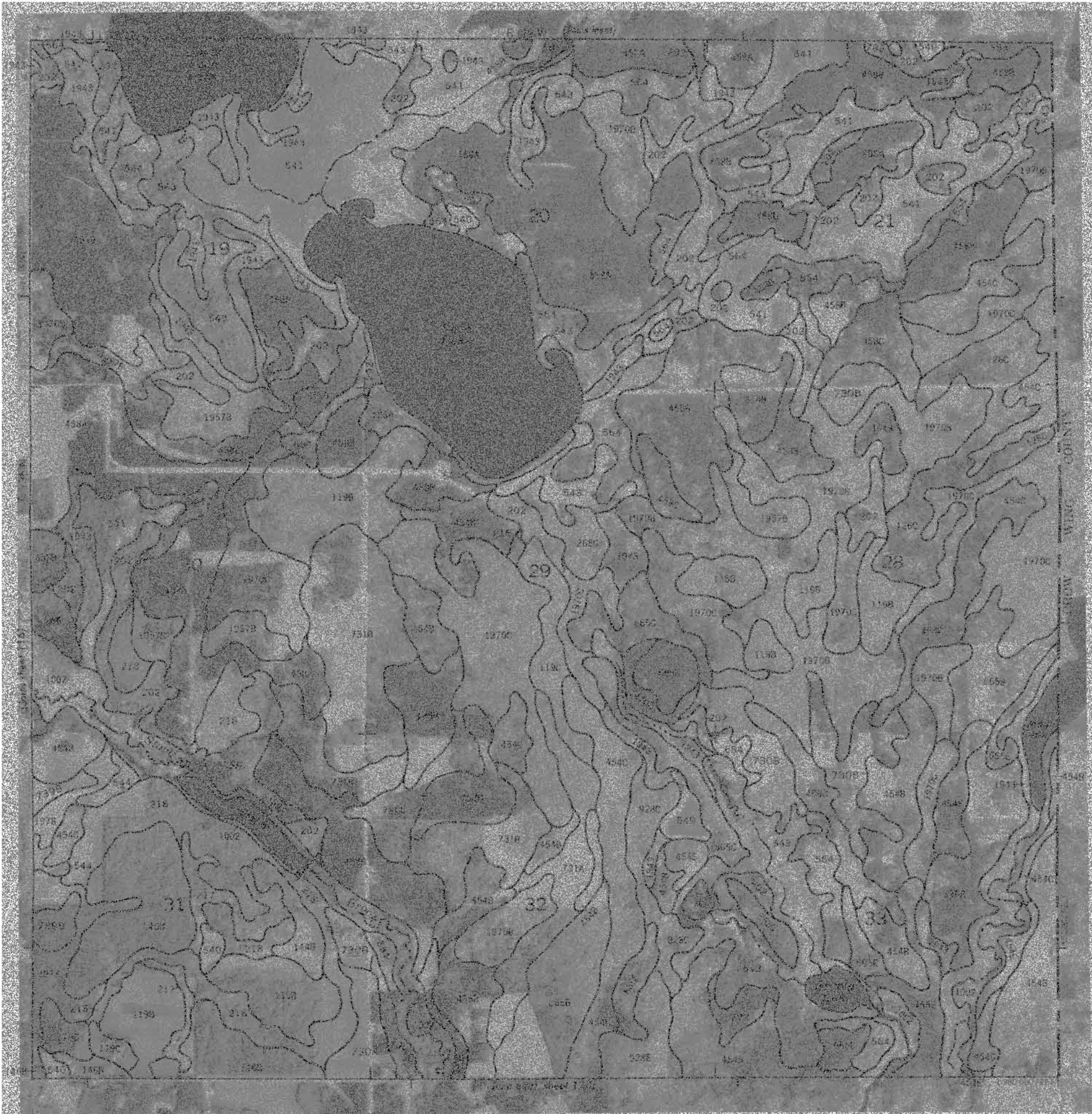










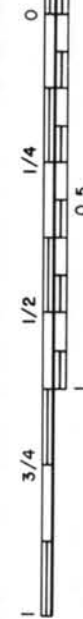






1 MILE

1 KILOMETER



(Joins sheet 118)

(Joins sheet 122)

